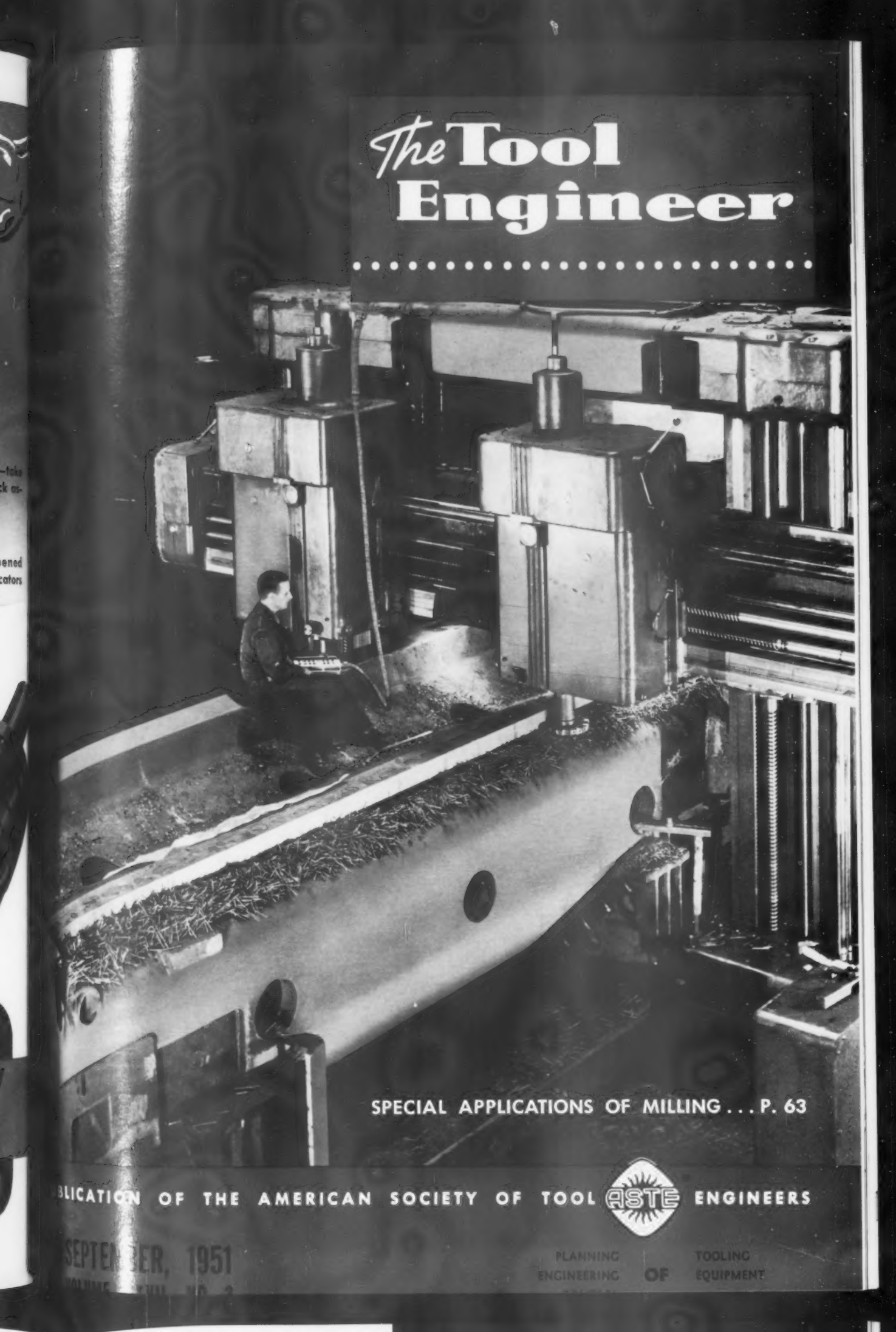
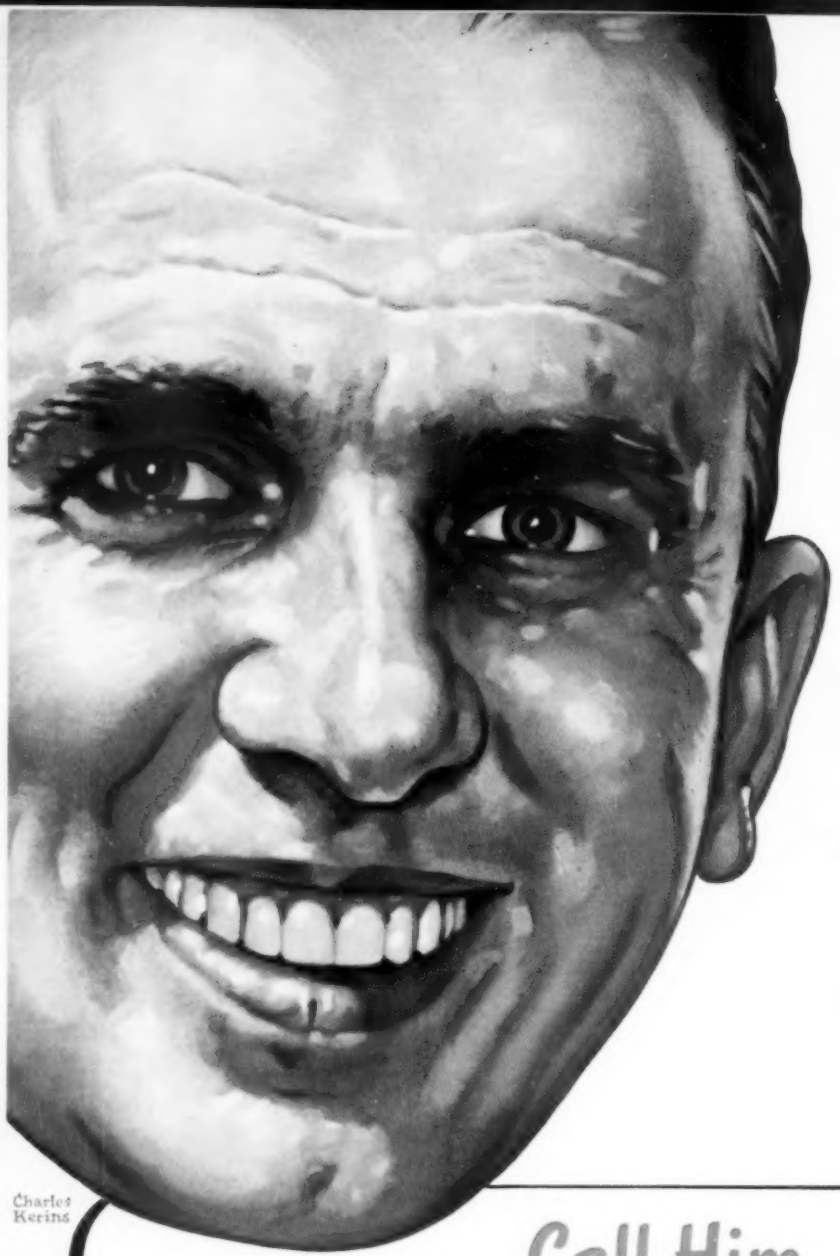

The Tool Engineer
SPECIAL APPLICATIONS OF MILLING . . . P. 63
BLICATION OF THE AMERICAN SOCIETY OF TOOL ASTE ENGINEERS
SEPTEMBER, 1951
PLANNING ENGINEERING OF TOOLING EQUIPMENT



Charles Kerins

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He's the factory trained Pratt & Whitney Sales Engineer from your nearby P&W Branch Office . . . an able, alert expert who can give you valuable assistance in obtaining more production from your machine tools, better performance from your cutting tools, and improved control of product-quality from your gages and gaging equipment.

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ENGINEERING OF EQUIPMENT

VOLUME XXVII
NUMBER 3
SEPTEMBER, 1951

The Tool Engineer

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AMERICAN SOCIETY OF TOOL ENGINEERS

THE TOOL ENGINEER is published monthly in the interest of the members of the American Society of Tool Engineers. Entered as second-class matter, November 4, 1947, at the post office at Milwaukee, Wisconsin, under the Act of March 3, 1879. Yearly subscription for members, $2.00. Non-members, $6.00. Canada, $6.50; all other countries, $8.00 per year.

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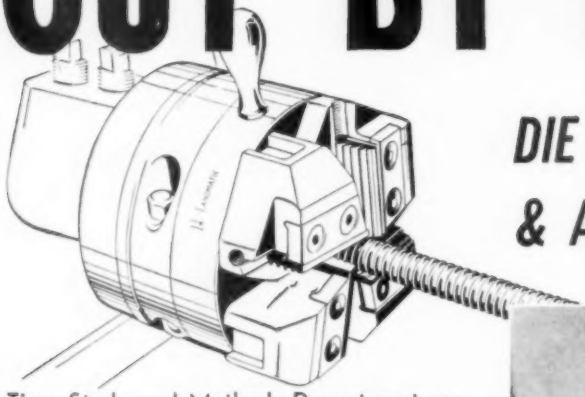
THREADING COSTS CUT BY OVER 75%



DIE HEAD CUTS COST OF PRODUCTION & ASSEMBLY OF STABILIZER SCREWS

Time Study and Methods Department records of a large aviation equipment company furnish data of still another job where LANDMATIC Heads have effected large savings in machine time and assembly and improvements in product quality.

In this operation, the 1¼" LANDMATIC Head on a turret lathe equipped with Leadscrew is cutting a ⅝-6 Acme thread on a Stabilizer Screw used by a light aircraft manufacturer. The thread was held to the close tolerance of ±.001 between the P.D. of the thread and the O.D. of the screw, for a full thread length of 5⅜" on cold-drawn piston stock, Spec. #AISI, B1112.

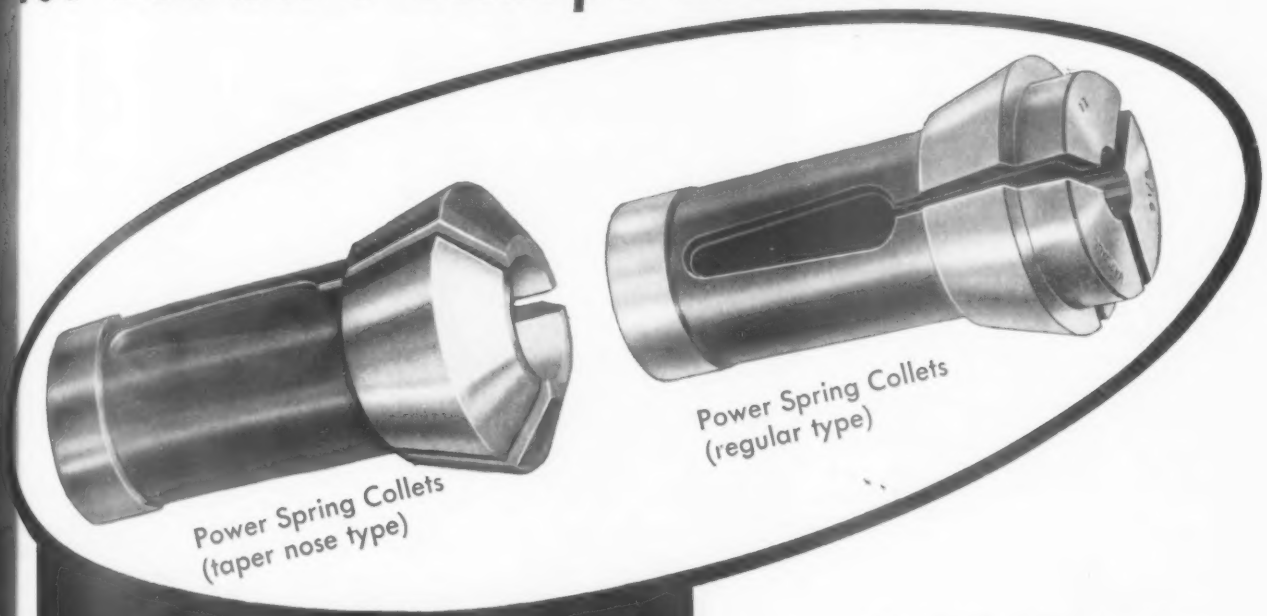
Former methods required two passes to produce the finished thread—one roughing and one finishing cut. The thread is now cut in one pass in .192 at a spindle speed of 230 R.P.M. Approximately 400 pieces are cut between chaser grinds. Hand fitting with the mating nut in assembly, previously necessary, has been eliminated. Total cost savings in all operations are in excess of 75%.

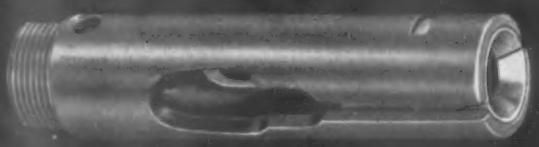
LANDMATIC Heads are stationary threading heads with self-opening action designed primarily for turret lathes. Their unusually-large oversize capacity makes them ideally suited for these machines. For detailed information and specifications, write for Bulletins F-80 and F-90.

LANDIS Machine COMPANY
WAYNESBORO, PENNA.

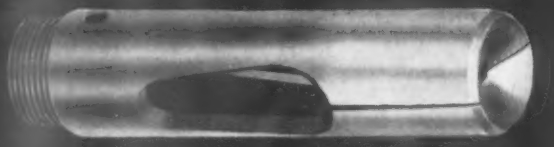
THREADING MACHINERY—THREAD CUTTING DIE HEADS—COLLAPSIBLE TAPS

HARDINGE ELMIRA, N.Y. COLLETS and FEED FINGERS for Brown & Sharpe machines

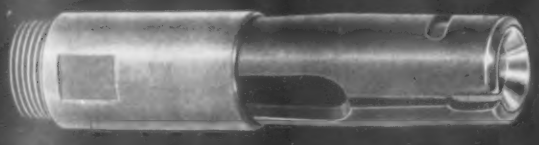




Master Feed Fingers and Pads



Feed Fingers (regular type)



Master Feed Fingers with Adjustable Tension for No. 00, 00G, 0 and 0G Machines.

To get maximum production efficiency from your Brown & Sharpe Automatics and Wire Feed Screw Machines — specify HARDINGE Collets and Feed Fingers.

Specifically engineered, customer-shop tested and approved for Brown & Sharpe Machines, Hardinge Collets and Feed Fingers will reduce tooling costs and step up production.

Write for Catalog 36 — contains complete descriptions, specifications and ordering information.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"

Mill and drill in the same chucking

Two high production drilling and tapping machines use a new 5 hp milling attachment

In one chucking of the housing 5 tools operate. One tool is a TC-tipped milling cutter, 5.5 in diam. It cuts at the rate of 1.9 cu. in. per min.

In 2 chuckings of the throttle body 31 tools operate. Two tools on the same arbor are TC-tipped milling cutters. A 2 in. cutter mills one boss in the second chucking. A 2.5 in. cutter mills 2 bosses in the first chucking.

The principle is not new. For years we have used milling attachments on drilling units with ½ to 3 hp motors.

But the milling attachment on these 2 machines is new. It is so heavy and rugged it needs 2.2500 diam. guide rods. (Our other attachments use 1.0000 or 1.3750 diam. rods.) It usually takes a 5 hp motor. Both jobs here are well within its capacity.

With this 5 hp milling attachment you can mill fairly heavy cuts in the same chucking with drilling, reaming, tapping and other operations. You can finish the part in fewer chuckings. You know the benefits of fewer chuckings —

More output per man hour
Accurate relationship of operations
Less handling and less floor space
Result: better product at lower cost

Unit costs in pennies

Man and machine cost 9/10¢ for all 5 operations on the housing. Man and machine cost 4-6/10¢ for all 31 operations on the throttle body. Here is the basis: 1) 80% efficiency, 2) the machine to pay for itself after operating only 6000 hours, a fraction of its useful life, 3) the present national average wage rate. No power or overhead.

Speaking of low costs, that reminds us of a story. One of our dealers called us the other day. "About our order so-and-so for a new Kingsbury," he said. "They are putting on the heat for a better delivery. Until they get that new machine, they say it costs them 10¢ too much to build each car."

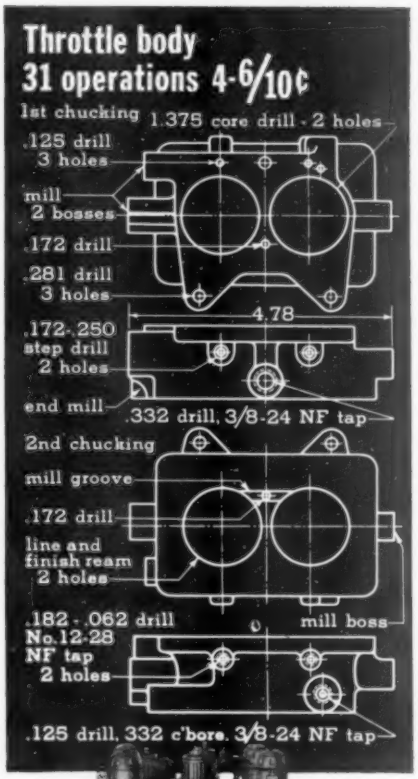
Our sales manager told this 4 times before he reached the "expediter."

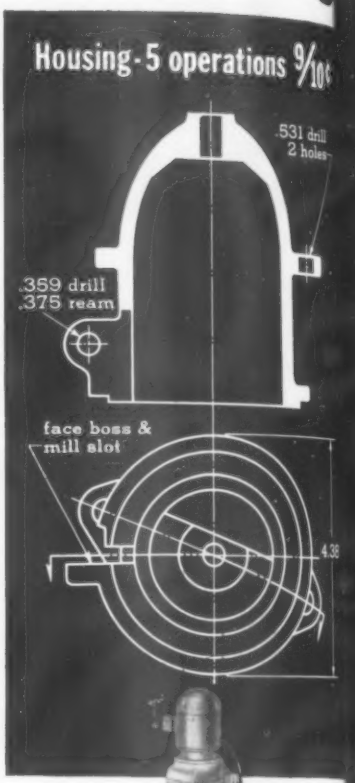
Do your parts cost too much?

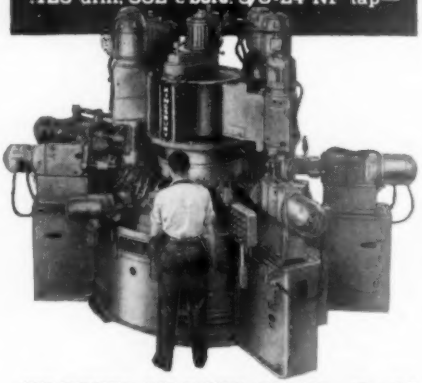
When you look for automatic machines to cut your costs, may we quote too? Send a print to our Mr. L. A. Carll. Tell him the operations and hourly output you need. We believe our proposal will merit your consideration.

Sincerely yours,

Kingsbury Machine Tool Corp.
50 Laurel St., Keene, N. H.







302 PARTS AN HOUR GROSS. On this 60-inch automatic indexing machine, 16 units do 31 operations on 4 sides of the throttle body in 2 chuckings.

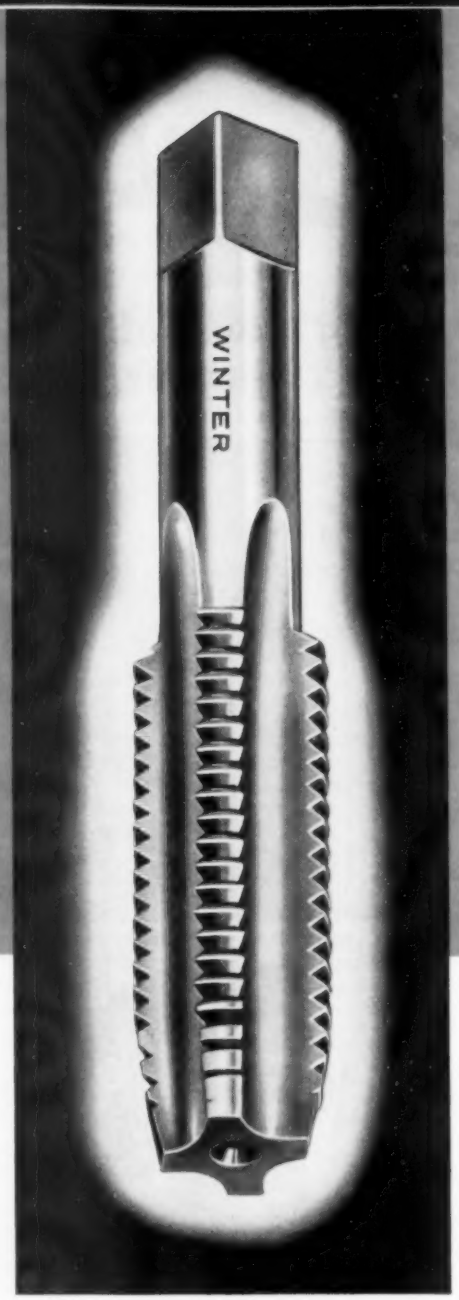
- On the central column are 10 vertical units. Only 8 show. After we made the photo the owner needed 2 more operations. We installed 2 units in the space we provided on the front of the column.
- Knees attached to the base support 6 horizontal units. (Originally 5 units; one more added later for a new operation.)
- A power wrench opens and closes the fixtures. (The man stepped aside so you could see it. That is why he does not look busy.)
- Ball bearing bushings guide the 1.375 core drills and line reamers. Regular bushings in piloted carriers guide the 13 other drills.

538 PARTS AN HOUR GROSS. You would never guess it from this picture but the cycle is only 5.5 seconds. During this time the man is supposed to remove a finished part and replace it.

- Operations are from 3 directions — Vertical: A unit with 2-spindle auxiliary head drills the two .531 holes. Horizontal, 45° left of the radial line: A unit with the new 5 hp milling attachment faces the boss and mills the slot with the same cutter. Horizontal, 45° right of the radial line: 2 units drill .359 and ream .375. (A bushing guides the drill.)
- The indexing table is 20 inches in diameter and holds 4 duplicate work fixtures.

KINGSBURY

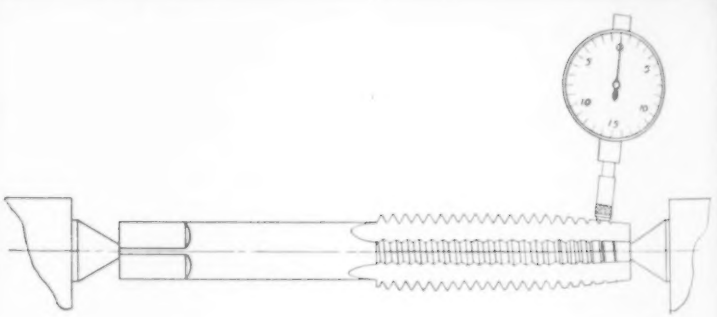
AUTOMATIC DRILLING AND TAPPING MACHINES
for Low-Cost High Production



QUALITIES OF CRAFTSMANSHIP
IN WINTER HAND TAPS

Accurate and Concentric Chamfers

For the production of uniformly accurate tapped holes all cutting edges must be truly concentric with the axis of the tap. They must also be of the same shape and of equal spacing. Accurate and concentric chamfers, along with exact flute spacing and uniform flute contours, are qualities inherent in Winter *Balanced Action* Taps. The complete Winter line includes hand, nut, chip driver, machine screw, pipe, pulley, and tapper taps, stocked conveniently at Winter branches in New York, Detroit, Chicago, and San Francisco.

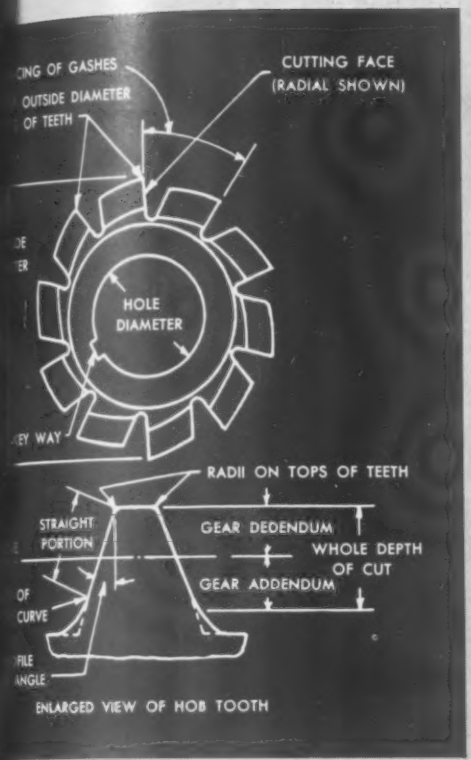


ALWAYS AT YOUR SERVICE

YOUR LOCAL DISTRIBUTOR carries a complete stock of WINTER Taps on his shelves—as close to your tapping problems as the telephone on your desk.

WINTER BROTHERS COMPANY • Division of the National Twist Drill and Tool Company, Rochester, Michigan, U. S. A. • Distributors in Principal Cities • Branches in New York, Detroit, Chicago, San Francisco

OINTS OF SUPERIORITY IN NATIONAL HOBS

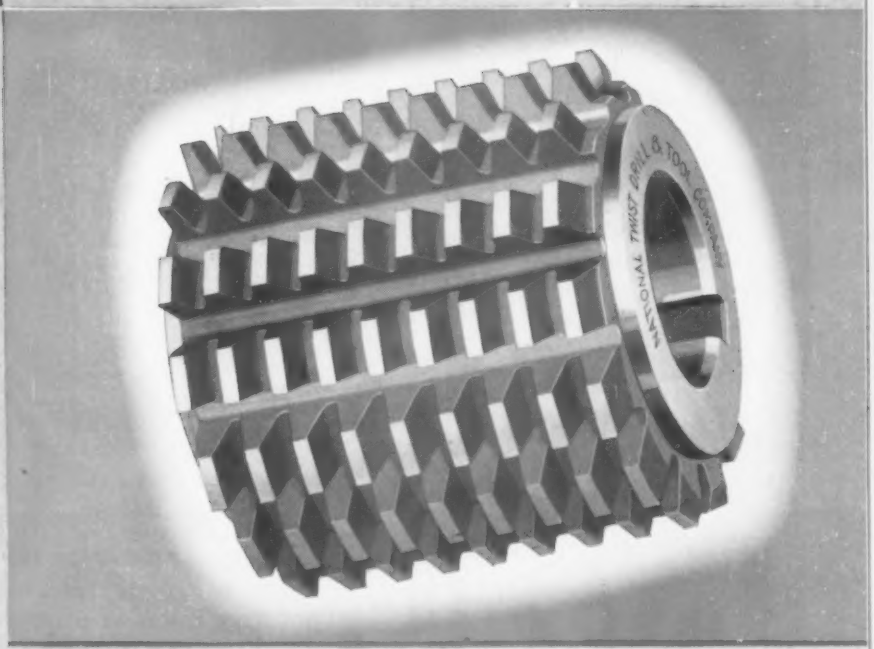


Manufacturing Control

Every step in the production of National Hobs, from hammer forging to final inspection, is subject to close manufacturing control. Blanks must pass both chemical and metallurgical laboratory tests before release to the manufacturing departments. Tooth size and shape must be absolutely uniform; hardening and tempering operations are carefully regulated to effect the best cutting qualities. Inspection, by means of specially designed gauges, maintains accuracies of finished hobs within close tolerances. National manufactures a complete line of cutting tools including twist drills, reamers, milling cutters, hobs, counterbores, and special tools.

CALL YOUR DISTRIBUTOR

LEADING DISTRIBUTORS EVERYWHERE offer complete stocks of NATIONAL metal cutting tools. Call them for cutting tools or any other staple industrial products.



NATIONAL TWIST DRILL & TOOL CO. ROCHESTER, MICH., U.S.A.

National

NATIONAL TWIST DRILL AND TOOL COMPANY • Rochester, Michigan, U. S. A.
Distributors in Principal Cities • Factory Branches: New York • Chicago • Detroit • Cleveland • San Francisco

RULES TO REMEMBER RE: REAMERS

1 Choose a line that is complete... for all types of applications

2 Be sure there are Field Men available to help you select the right tools and use them right

3 Insist on 100% inspection... each reamer inspected individually

4 Order Butterfield...the reamers that meet <u>all 3</u> specifications

TESTING HARDNESS of finished tools on a Rockwell Hardness Testing Machine.

Fluted Chucking Reamers
Taper Pin Reamers
Flex-Rite Expansion Reamers • Hand Reamers
Center Reamers and Countersinks
Stub Screw Machine Reamers

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In Canada: Rock Island, Quebec

BUTTERFIELD

THE 100% INSPECTED TOOLS

Every Tool Individually Inspected

TAPS • DIES • REAMERS • SCREW PLATES

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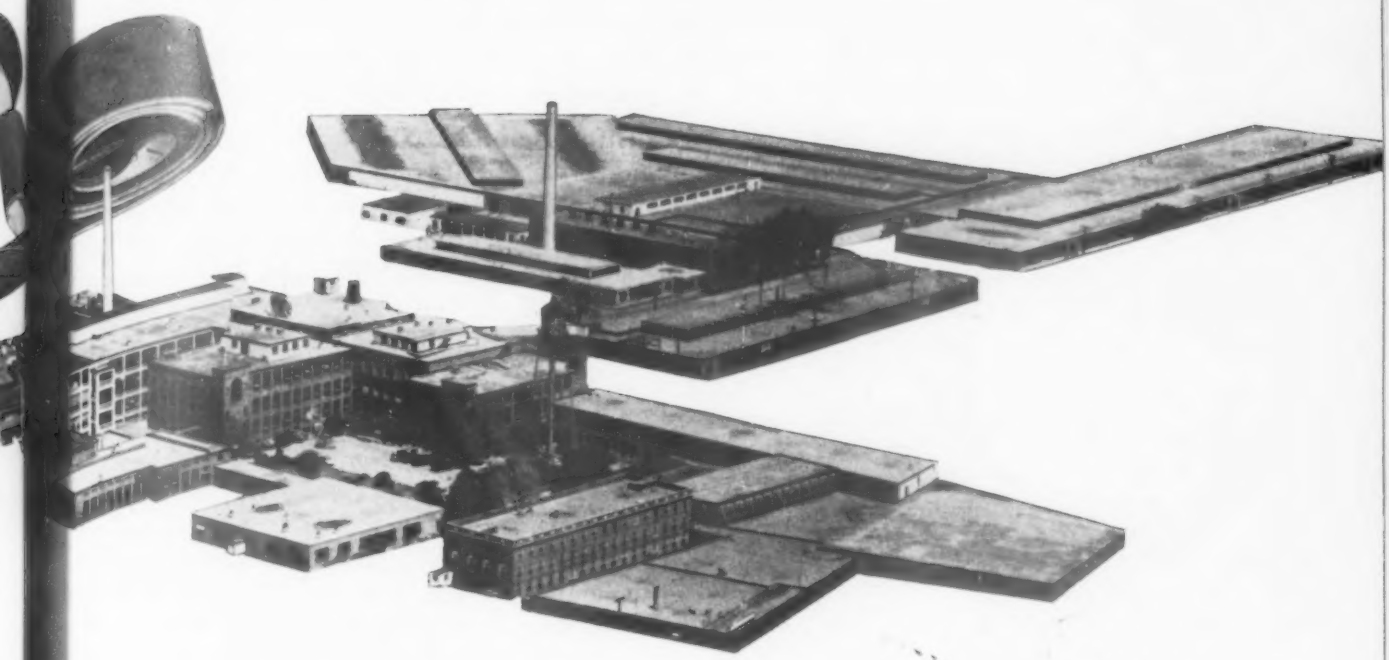
NORTON abrasives®

BEHR-MANNIN

COATED ABRASIVES · SHARPEN

ATED ABRASIVE PRODUCTS



BEHR-MANNING PRODUCES EVERYTHING YOU NEED IN COATED ABRASIVES

A statement like that takes in a lot of territory . . . but we can go even farther and say that BEHR-MANNING produces coated abrasive products that you *may not now know that you need*, but which if used in your production processes may well bring you important additional profits. For within the 30,000 coated abrasive products mentioned above, some are very new and their possibilities not yet generally realized.

Within the past seven years, BEHR-MANNING research and development engineers have brought out and field tested *58 entirely new abrasive products*. In the same period they have achieved *235 product improvements*. This process is continuous — BEHR-MANNING research never stops.

TO MAKE SURE that your grinding and polishing methods are *right* for your needs — utilize the BEHR-MANNING Methods Room located nearest you. Take advantage of the abrasive engineering experience available there, without obligation. Try out the latest abrasive methods on your own work.

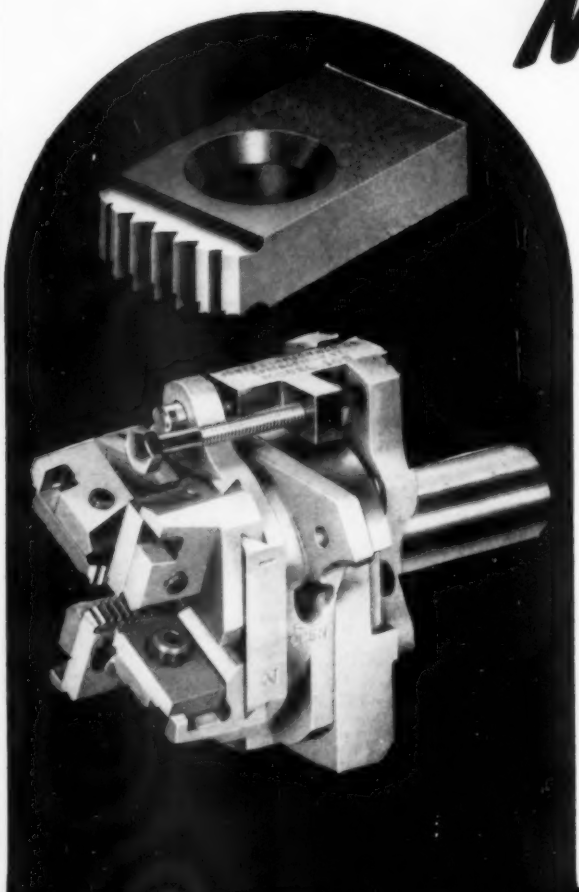
Full details on this free service, and location of Methods Room nearest you, are covered in the book, "Proving Ground for Production." Write for your copy today. Address Dept. T.E-9.

TROY, N. Y. DIVISION OF NORTON COMPANY

ONES · PRESSURE-SENSITIVE TAPES

EXPORT: BEHR-MANNING OVERSEAS INC., NEW ROCHELLE, N. Y., U.S.A.

NEW Nos. 16-S, 18-S, and 19.
Jones & Lamson Die Heads



Designed and built for high production quality threading, the new J&L dies perform with smooth, easy action, unusual repetitive accuracy, and year 'round dependability at low cost. They will give you maximum productive machine hours each day.

No. 16-S is for use on No. 00 and 00G and No. 0 and 0 Brown & Sharpe Automatics and small turret lathes. It uses long wearing ground thread, radial type chasers *with* two cutting *edges*. These DUALIFE chasers are easily and quickly removed and replaced in their holders. When one edge wears out, just turn them over, and you have the equivalent of a new set of chasers. Minimum down time and maximum production results.

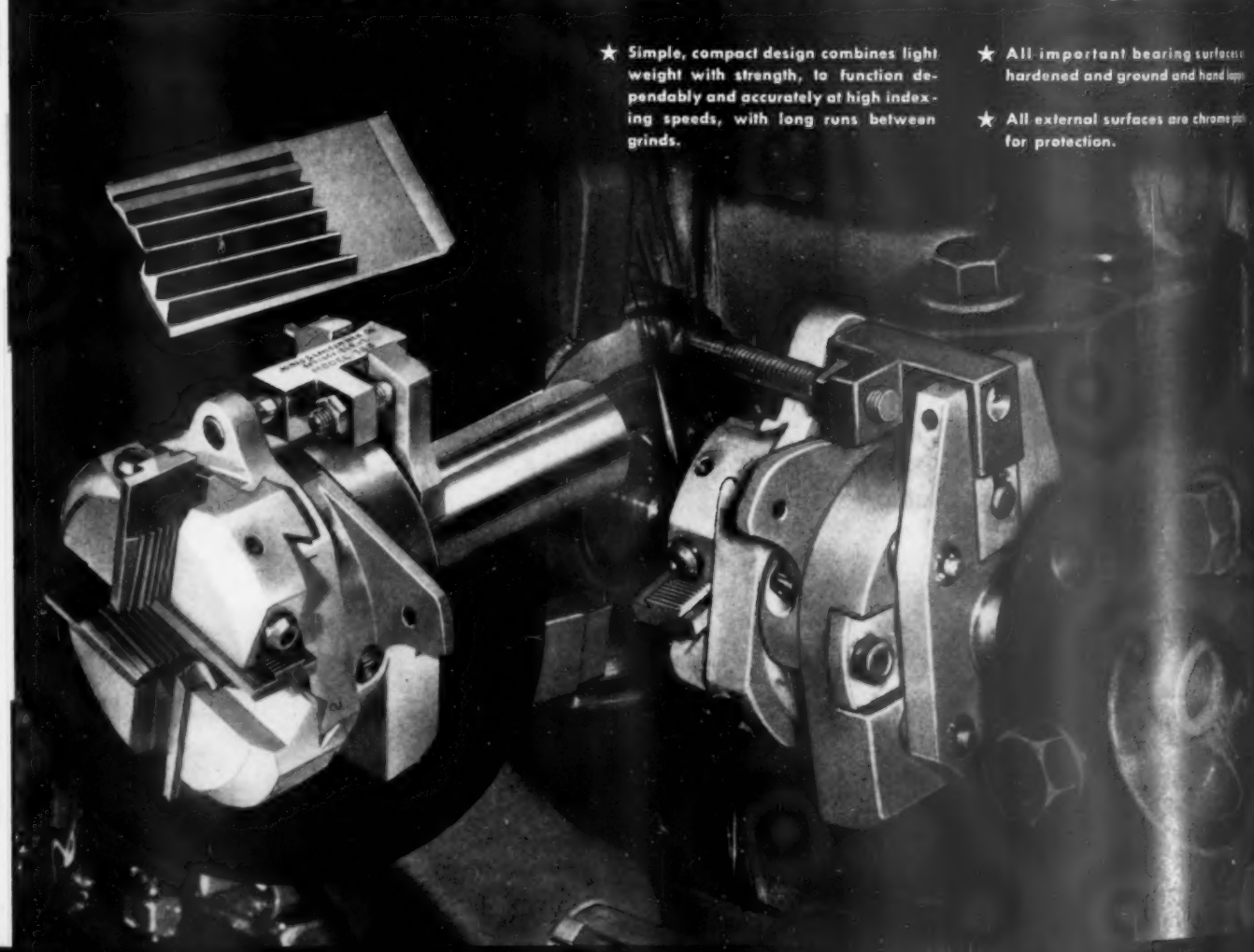
No. 18-S and 19-S Model 18-S is for use on No. 0, 0G and No. 2, 2G Brown & Sharpe Automatics. Model No. 19-S with wider capacity range, is for use on No. 2, 2G Brown & Sharpe machines. Both are also used on small turret lathes. They have Tangent type chasers, ground all over, incorporating the exact helix angle and thread form. They are easily removed and replaced without disturbing the head and holder assembly. Many of these chasers are interchangeable between the two models and other standard J & L Tangent Die Heads. Carbide chasers can be used when conditions permit.

for Brown & Sharpe Automatics and Small Turret Lathe Applications

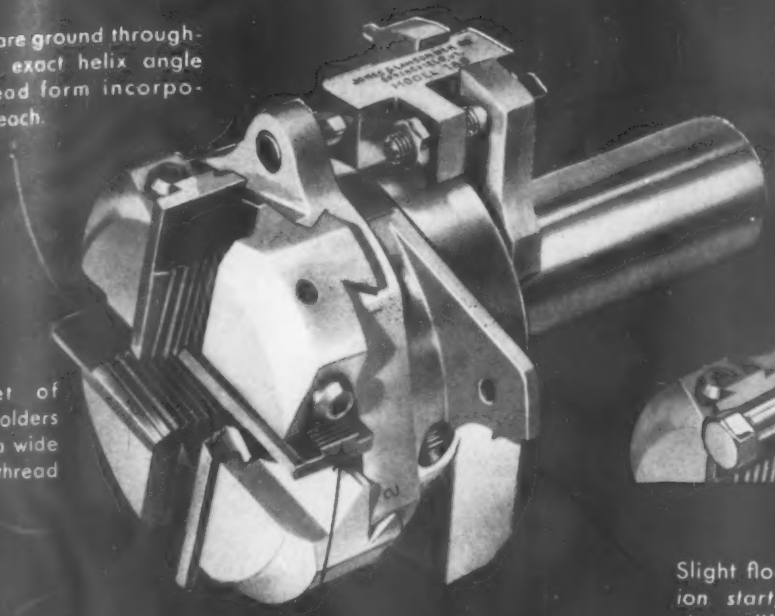
★ Simple, compact design combines light weight with strength, to function dependably and accurately at high indexing speeds, with long runs between grinds.

★ All important bearing surfaces hardened and ground and hand lapped.

★ All external surfaces are chrome plated for protection.



Chasers are ground throughout; with exact helix angle and thread form incorporated in each.



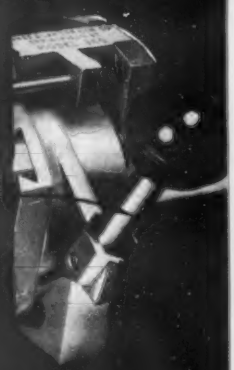
Adjustable Trip, quickly converted for either PULL OFF or EXTERNAL TRIP. Easy, quick opening prolongs both chaser and die life, increases runs between grinds.

One set of chaser holders handles a wide range of thread sizes.

Leading edge of chasers extends beyond face to permit threading close to shoulders.

Chasers can be changed and set quickly, easily and accurately. A few turns of a *single* screw will release or secure each chaser in its holder.

Slight float provides *cushion start*, helps prolong chaser life.

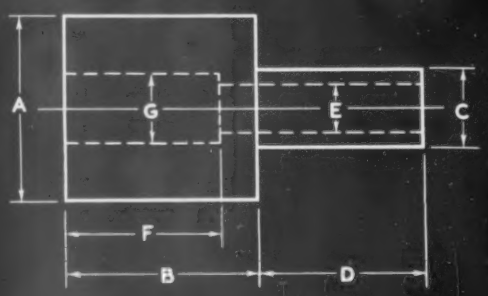


All three models can be furnished with a lever locking handle, for use on small turret lathes.

pecifications for Nos. 16-S, 18-S, 19-S Jones & Lamson Die Heads

NO.	CAPACITY	THREAD	LENGTH
16-S	No. 0 through 3/8" (Coarsest standard Pitch-18 TPI)	No. 0 through 3/8" dia.	Any length
18-S	No. 4 through 9/16" (9/16" holders Coarsest standard Pitch-12 TPI)	On No. 0 & 0G B & S machines	
		No. 4 through 7/16" dia.	Any length
		Over 7/16" through 9/16" dia.	Max. length 1-7/8"
		5/8" dia.*	Max. length 1"
		On No. 2 & 2G B & S machines	
		No. 4 through 9/16" dia.	Any length
		5/8" dia.*	Max. length 1-1/8"
19-S	No. 4 through 9/16" (9/16" holders Coarsest standard Pitch-12 TPI)	No. 4 through 9/16" dia.	Any length
	5/8" through 1" (1" holders Coarsest standard Pitch-10 TPI)	5/8" dia.	Any length
		Over 5/8" through 1" dia.	Max. length 2-1/4"
	7/8" through 1-1/4" (1-1/4" holders Coarsest standard Pitch-12 TPI)	7/8" through 1" dia.	Max. length 2-1/4"
		Over 1" through 1-1/4" dia.	Max. length 1/2"

*For special application only



Write for catalogs describing our complete line of Tangent Dies *up to 2" dia. capacity, and* Radial Dies *up to 4¼" dia. capacity.*

Die Head Division

JONES & LAMSON

MACHINE COMPANY

Springfield, Vermont, U.S.A.

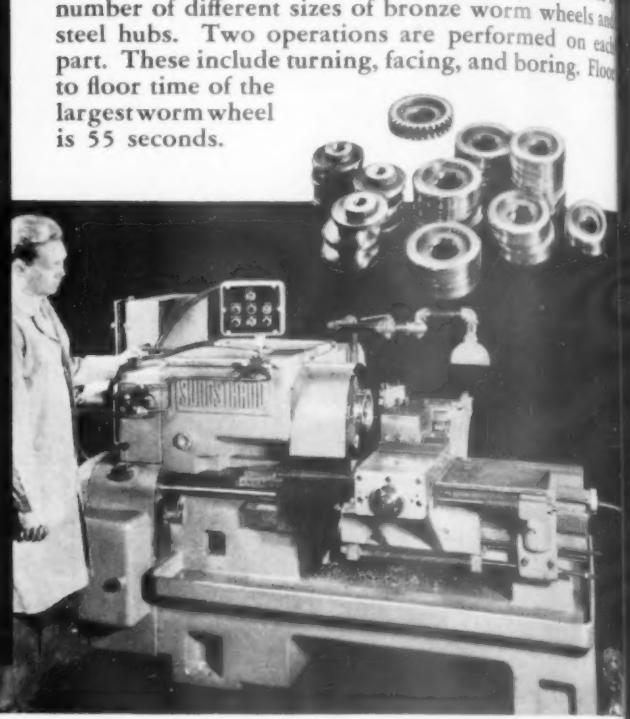
MACHINE TOOL CRAFTSMEN SINCE 1835

FACTS about Sundstrand Automatic Lathes

that mean increased production on jobs like these . . . . . .

1. Small Lot Turning...

This Model 8A Automatic Lathe machines a number of different sizes of bronze worm wheels and steel hubs. Two operations are performed on each part. These include turning, facing, and boring. Floor to floor time of the largest worm wheel is 55 seconds.



Some facts about the Design Features that make this production possible . . .

The illustrations above show 3 of the 8000 or more installations of Sundstrand Automatic Lathes. These are new lathes and embody all of the latest design features. Many users have changed from old to new Sundstrand Automatic Lathes in order to get the maximum production resulting from design improvements.

The following features, incorporated in the design of the latest models of Sundstrand Automatic Lathes will also help you increase your turning production:

• Greater Horsepower

All new Sundstrand Automatic Lathes have been redesigned for greater rigidity and larger spindle drive motors. They have ample power for use of carbide cutting tools and are capable of doing more work.

• Wider Speed Range

Spindle speed range ratios have been increased to 30 to 1 to obtain maximum in cutting efficiency over a wider range of sizes of parts and material. The spindle unit is equipped with two driving gear centers, which increase the range between high and low spindle speeds. In addition, four speed changes can be obtained from one set of gears instead of the usual two.

• Wider Feed Range

A wider feed range has been provided to enable the handling of a greater range of parts and materials at maximum cutting efficiency. The New Models 4A, 8A, and 12A have a ratio of 18 to 1 between high and low feeds — Model 16 has an even greater range.

• Greater Carriage Adjustment

Both front and rear carriage of the latest Sundstrand Automatic Lathes are adjustable full length between headstock and tailstock centers — another important new feature.

• Faster Set-Up

Convenient location of pick-off gears for changing spindle speeds and front and rear carriage feeds is provided. Feed and speed chart and pick-off gear storage compartment are readily accessible for quick set-up or changeover.

• Quick Cycle Changeover

Complete control of all cycles is provided by adjustment of dogs on a disk. Making cams is eliminated. Changing position of dogs on disk changes length of rapid approach, feed and rapid return strokes — enables operator to set up cycle quickly and change over from one job to another easily.

• Automatic De-Clutching

All new models have been provided with automatic declutching between spindle and spindle motor with self-adjusting magnetic clutch and brake for quick stopping of spindle rotation.

• Screw Feed to Front Carriage

All new Sundstrand Automatic Lathes have screw instead of rack feed to the front carriage — resulting in fine finish and long tool life.

SUNDSTRAND

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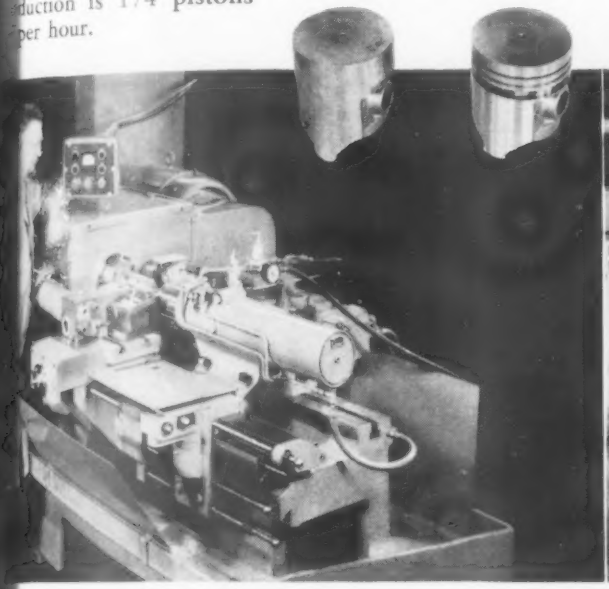
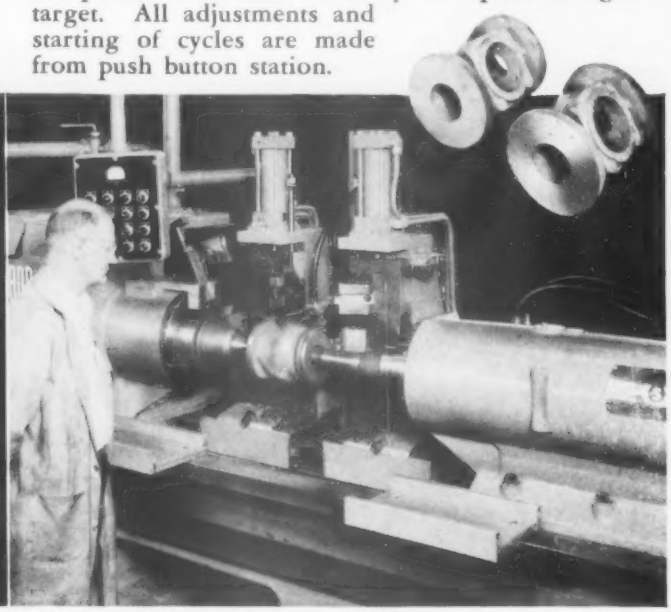
2. Long Run Turning

This Model 8A elliptically turns the O.D., faces the head, roughs, finishes and chamfers the grooves of automotive pistons. Front carriage is oscillated by a cam with power take-off from spindle for turning O.D. The cross-feeding rear slide simultaneously faces, grooves and chamfers. Production is 174 pistons per hour.



3. Special Turning

Both ends of valve bodies are machined simultaneously on this special Model 16 Lathe. Automatic cycle includes facing flanges, indexing of tools for "phonograph finishing" in a 2nd cut and return. Each carriage mounts a slide on which two tool blocks are vertically indexed in two positions. The work is held between centers on an arbor, and tools are positioned to the work by air operated sight target. All adjustments and starting of cycles are made from push button station.



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REAR SLIDE: Max. Stroke	4"	5½"	6½"	8"
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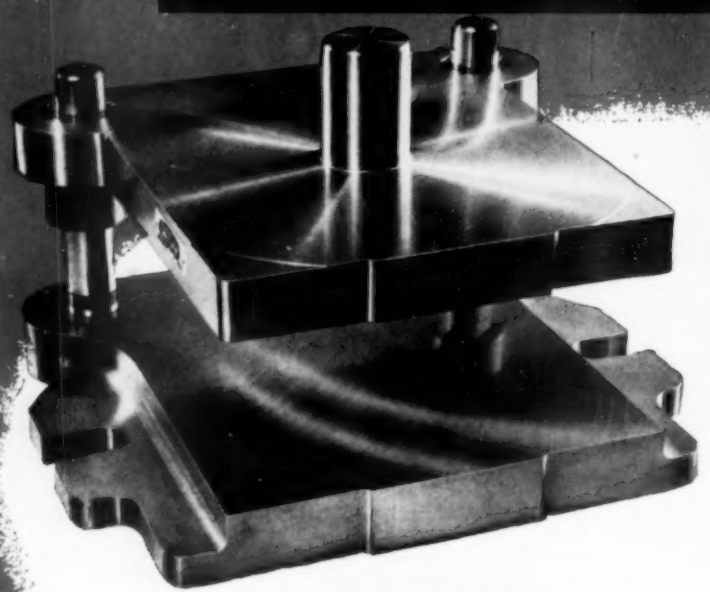

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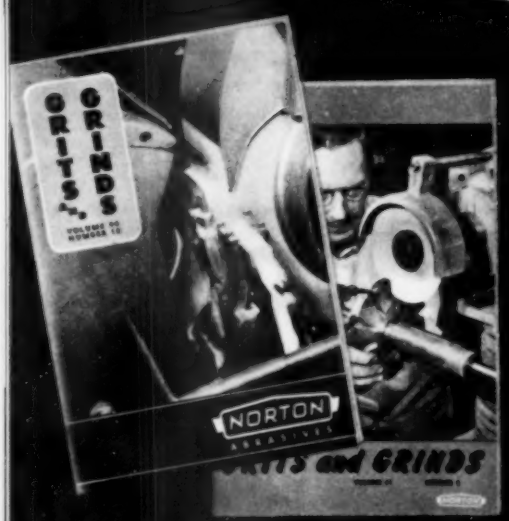

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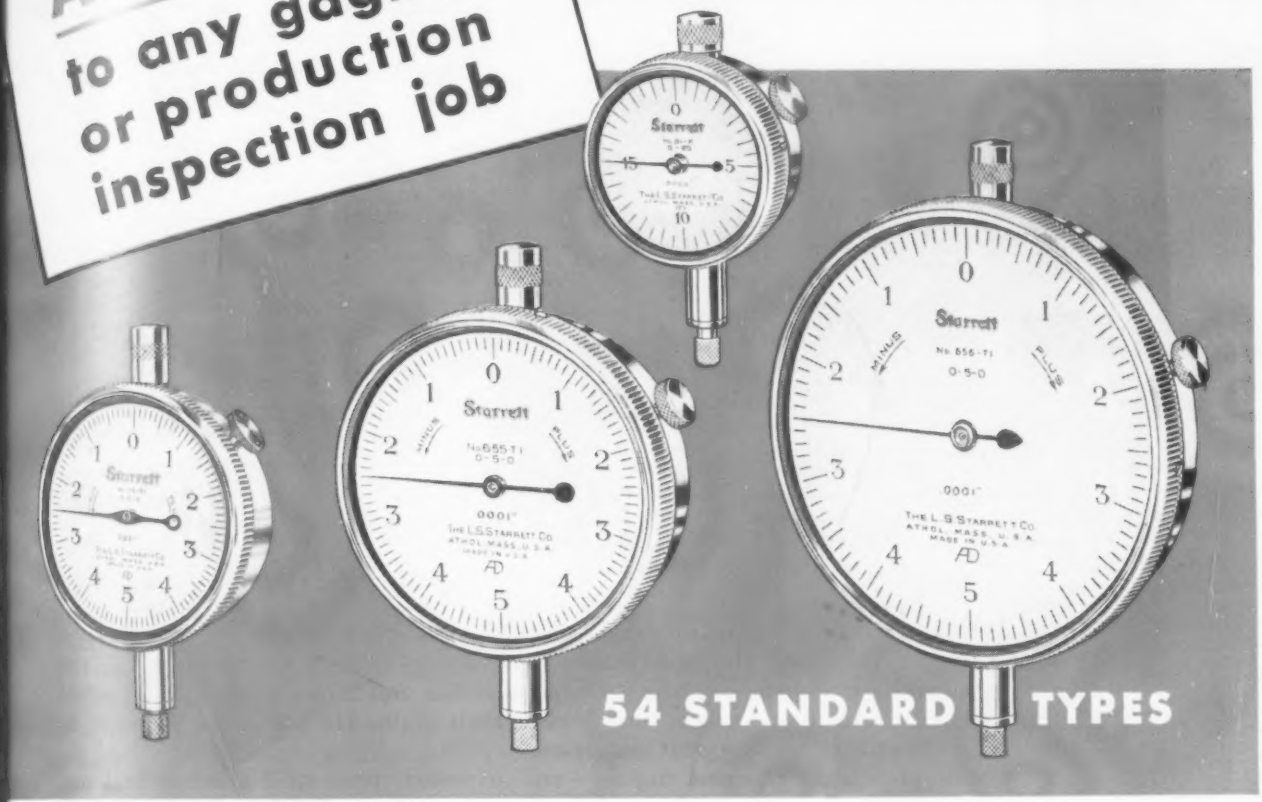

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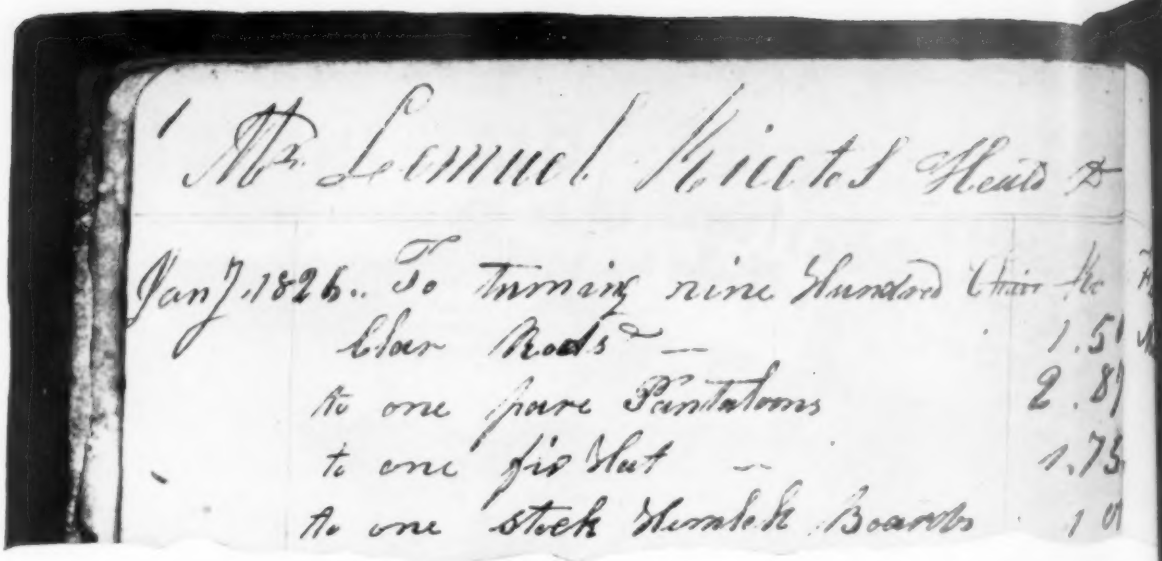
Mr. Lemuel Rice to S. Heald Dr

Jan 7. 1826.. To Turning nine Hundred Chair Rods — 1.50

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GETS TO THE POINT

The **Tool Engineer**

a Letter from the Editor...

Response to *The Tool Engineer* clearinghouse, as announced in this column during the past two months, has been direct and with a great deal of potential. We have heard from officials of industry and government, and full cooperation seems assured.

As is pointed out in the special report included in this month's issue of *The Tool Engineer*, the job that lies ahead in tooling up for defense is an immense one. No group of men can do it alone; it requires all our efforts expended jointly.

And this is where we hope, through the clearinghouse service, to bring together industries with manufacturing and tooling difficulties and industries which have open capacity that can be brought into the effort.

Naturally, not every shop in the country can produce machine tool components; not all shops are capable of manufacturing high-precision dies. But many shops in both categories have open capacity that can be put to use in getting industry geared to defense production. It is our job as tool engineers to see that these plants are utilized to our nation's best advantage.

Gilbert P. Muir

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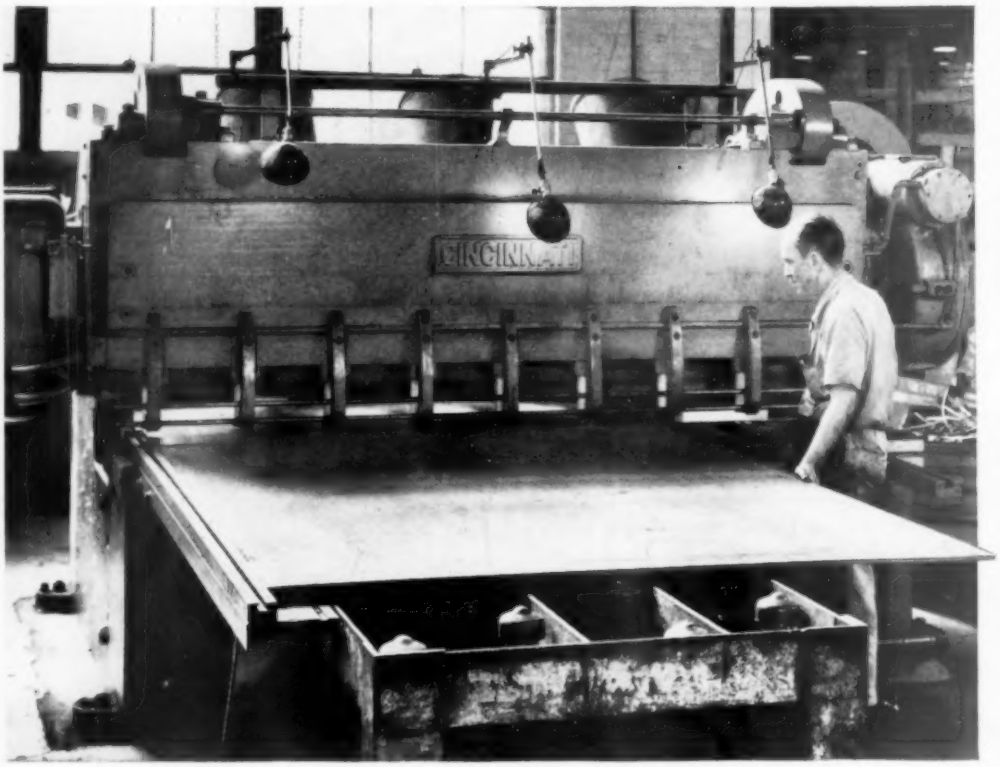

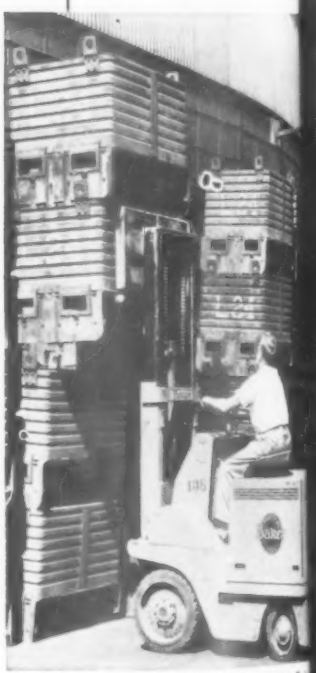

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The Tool Engineer

Editorial

Regional Meetings—A Plan for the Future

NEXT MONTH, IN EVANSVILLE, Indiana, ASTE inaugurates its newly-completed plan for regional technical meetings spotted at key points in the United States and Canada. As the first of these meetings, Evansville will provide our Society with an opportunity to study further the effects of localized meetings, and how they can be made of greatest use to tool engineers and industry.

Regional meetings can be an important part of our efforts in promoting interchange of tool engineering data and discussion of professional tooling problems. Designed to draw attendance from a radius of one hundred-fifty to two hundred miles, they enable tool engineers to participate who otherwise might have to miss national meetings because of pressure of work.

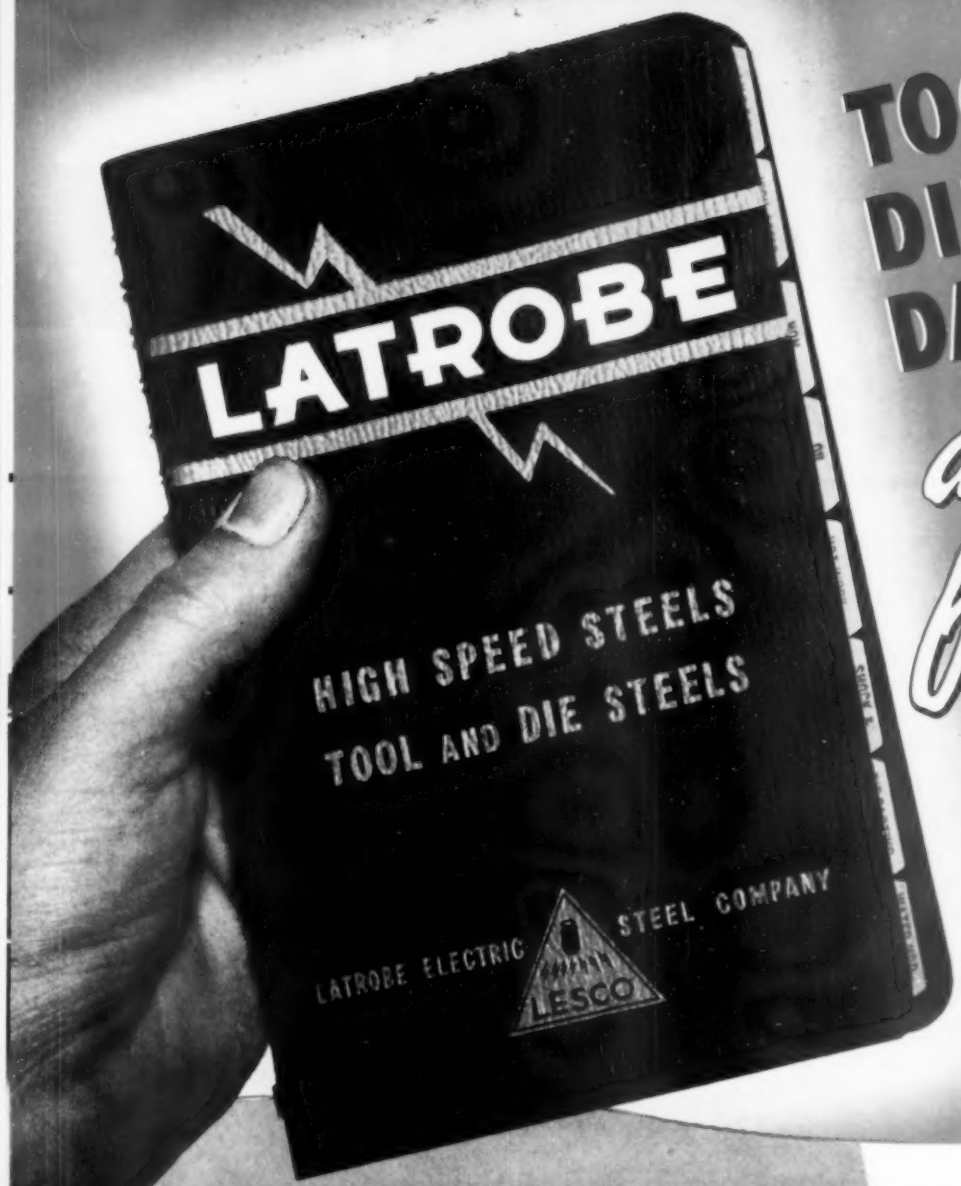
If, with the help of ASTE members and industry, we can make these regional meetings a permanent success, the advantages of personal attendance at technical sessions and discussions will be brought to thousands of tool engineers over the continent. Several times over the present number of tool engineers who can attend national technical sessions will be able to play a personal role in our professional educational efforts.

The planning of regional meetings also ties in significantly with our national defense efforts. First is the fact suggested above that increasingly more tool engineers may find it difficult to spend a great deal of time away from the plant. Second, possible transportation restrictions in the event of a full-scale mobilization effort will make the regional meeting the only practical alternative.

As the technical society of the tool engineering profession, we have a large and important obligation in furthering ever higher development of our profession. Let us work to insure that the regional meeting will be another method of furthering this development.

J. J. Demuth

PRESIDENT
1951-1952



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Production Drilling and Trepanning of Deep Holes

By J. S. Ladendorf

DEPUTY DIRECTOR, WOHLFAHRT PROCESS DIVISION
WOHLFAHRT ENGINEERING AND MANUFACTURING COMPANY

THE DEMAND FOR DEEP-DRILLED holes of considerable depth has spread to an extent where conventional processes have been found wanting, particularly in such operations as the drilling of propeller shafts, long spindles, oil drills and oil drilling equipment, gun tubes and other ordnance products.

For the most part these products, since they are symmetrical, can be rotated on special lathes or deep hole drilling equipment which allow stationary deep hole drills to be used. With only a few exceptions, the parts are in rotation and the tool is stationary.

The process described here was initiated in Germany during the recent war; it was brought to development in 1948 when a plant associated with our firm, located in the U. S. Zone of Germany, received a contract to produce oil drilling equipment.

Realizing the interest that gun manufacturers have had for our process in England, we advised the gun manufacturers, both civilian and governmental agencies, in the United States early in 1950 on our deep hole drilling operation. Using the same basic principles of our deep hole drilling operation, with the exception of rifling, we have designed machines and tools to completely machine the bore of gun barrels.

This report on the complete treatment of deep holes shows the evolution of the new types of machines and tools as well as presenting pertinent production data.

The Wohlfahrt method for deep hole drilling employs a special tool or cutter, but in addition it is the method of performing this operation that is responsible for the high increase in production. The Wohlfahrt deep hole drilling operation considers the following factors:

a. Rpm
b. Feed
c. Size and shape of the chip
d. Chip removal
e. Mounting and control of the drill head tubular carrier
f. Construction and handling of the oil feed apparatus
g. Type of coolant
h. Coolant pressure
i. Coolant temperature
j. Design and construction of the drill head
k. Grade of tungsten carbide
l. Diameter to be drilled
m. Design of tungsten carbide cutter for cutting angle, with chip-braker feature
n. Elimination of all vibration
o. Proper method of starting the drill into the work to insure concentricity
p. Handling of the part

The old methods of deep hole drilling with high speed steel or tungsten carbide tipped spiral drills, on-lip drills and core drills are well known, so that we need to mention them only as a comparison to show the relative increase in production. The graph in Fig. 1 compares these drilling methods.

For the drilling of a hole 2.766 inches in diameter it was possible to increase the production thirty times as compared to using conventional high speed steel tools.

Several types of tools have been devised for the deep hole drilling in order to determine the most economical tool for a specific diameter hole to be drilled. Three distinct types of tools have been designed and adopted by this organization and they are discussed as follows:

Deep Hole Drilling—Type 1:

This type is similar in appearance to conventional one-lip drills except that the coolant is fed from the inside of the drill and the coolant and chips are returned on the outside. Fig. 2 shows the general arrangement for coolant and chip control. This drill is most satisfactory for drilling holes from approximately $\frac{3}{16}$ in. diameter through 2 in.

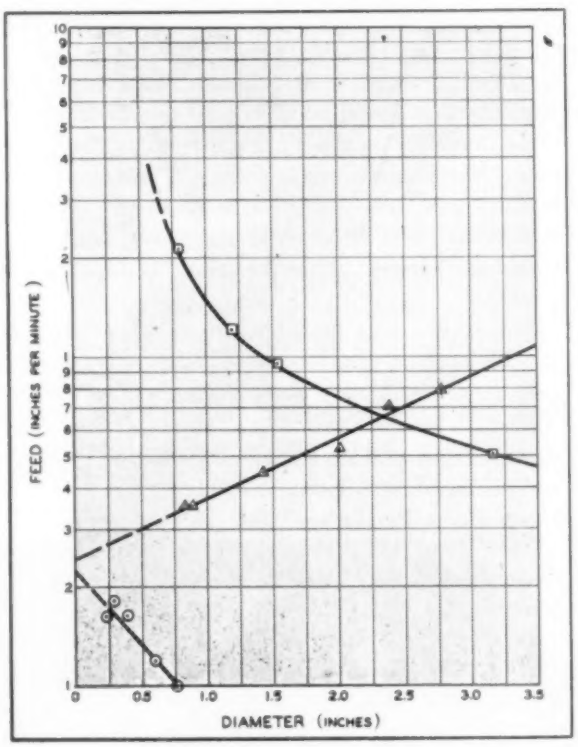
diameter. However, from the graph in Fig. 1, it can be seen that the drill can be used economically for drilling holes up to approximately $^{23}/_{32}$ in. diameter. Further, the use of tungsten carbide instead of high speed steel is also shown as a distinct advantage.

With the internal feed of the coolant under high pressure, the coolant is forced through to the leading edge of the drill between the two carbide guides, forcing the chips into the chip passage where they are expelled out of the workpiece. Among the patented features of the drill head is the form to which it is ground, thus increasing its life. To balance the pressure caused at the cutting edge, two carbide guides are provided. This reduces vibration and thus helps control the concentricity of the drilled hole as well as increasing the life of the cutting edge. Because of the high speed vibrationless rotation of the workpiece, the diameter of the drilled hole can be held to very close limits from end to end, thus precluding a subsequent boring operation. Table I gives average production data using deep hole drilling—Type 1.

Experience indicates that, in drilling small diameter holes with this drill, a 300 percent increase in speed over conventional methods is realized. For example, for drilling a $^{5}/_{16}$ in. diameter hole, 20 in. deep, it formerly required 30 minutes while with the Type 1 drill, the average is 10 minutes.

Tests have been made to improve this drill for drilling holes over $^{23}/_{32}$ in. diameter. However, it has been found to be impractical. The shape of the drill head, for larger diameters, does not allow sufficient support to be incorporated to control vibration. Another drill profile design was not possible, as this profile was required for removal of the chips. To overcome the support problems of the Type 1 drill for larger diameter drilling, Type 2 deep hole drill is used.

Fig. 1. Graph compares old drilling with modern method. Note relationship between rate of feed and diameter in deep hole trepanning.

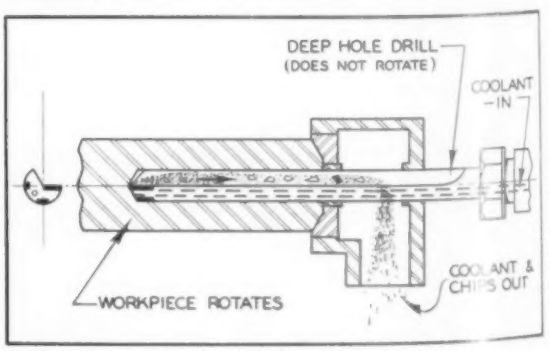


Deep Hole Drill—Type 2

Figs. 3A and 3B show the general arrangement of the second type of deep hole drill. Compared to the drill just discussed, it will be seen that in the Type 2 design, a tubular bar replaces the profile bar. Further, Type 2 has a replaceable drilling head. This is advantageous for rapid replacement of the drill as well as being a more economical drill to produce. The coolant is forced under high pressure along the outside of the tubular carrier to the forward end of the tool head. Chips are forced by the coolant through the center of the tool head and through the center of the tubular carrier, then both chips and coolant are expelled at the opposite end of the carrier. The coolant then passes through a gravity and magnetic separator, through a refrigeration unit and finally back into the machine. Fig. 3 best shows this tool in operation with notation as to flow of coolant and chips. Note that the chips never come into contact with the inside wall of the hole just drilled, thus insuring a smooth, unscoured bore. The essential characteristics of this drill head are: (1) form of the cutter, (2) internal passage to return coolant and chips, (3) chip breaker feature and (4) position and size of the carbide guides which balance pressure caused by the carbide cutter.

The circular cross-section of the tubular carrier allows greater pressures of coolant without deformation. As a result, the coolant acts as a cushion when it is forced between the wall of the bore and the carrier, reducing vibration to a minimum. The longest part yet to be drilled with this method was the drilling of a three-inch hole through 65 feet of forged steel with a hardness of 30 Rockwell—"C" Scale. Compared with Type 1 drill, Type 2 can effect four to ten times higher production. For

Fig. 2, showing Type 1 drill, gives general arrangement for coolant and chip control.



example, a hole 4 in. in diameter can be drilled with a feed of 4.75 to 5.50 in. per minute. (See Graph in Fig. 1.) Concentricity can be held to closer limits than with the one-lip drill. The diameter of the bore can be held within 0.002 in. or closer depending upon the material being drilled.

The following considerations were found important when using this drill:

1. Proper placing and chucking of the workpiece
2. Proper coolant pressure
3. Proper construction of the coolant inlet apparatus (oil feed mechanism)
4. Sealing the workpiece to withstand coolant pressure
5. Control of coolant pressure, as pressure may have to be changed
6. Proper placement of the drill head
7. Accurate control and guidance when drill starts into workpiece

Table II gives production data from several deep hole drills—Type 2. While the data in Table II were found from drilling steel forgings, this method of drilling is most successful when drilling cast iron.

Fig. 4 shows the general arrangement for the special oil feed apparatus. It will be seen that the workpiece is supported by a special collet chuck which in itself is a part of the oil feed apparatus. The general construction of the unit insures a positive seal for the coolant system between the workpiece and the oil feed apparatus even when operating at high coolant pressures. A drill bushing is positioned immediately ahead of the workpiece and is ground to a diameter of the hole being drilled. The guides on the drill head are in turn guided by this bushing, which can be easily changed to allow the oil feed apparatus to drill holes of different diameters. The tool head tubular carrier slides within the oil feed apparatus, during which time the coolant and chips are expelled through the center of the tubular carrier. Both the inside and the outside of the tubular carrier must be smooth and the outside diameter must be held to close limits; this provides a good oil seal.

Deep Hole Drilling—Type 3

The optimum tool head design for deep hole drilling was the development of the trepanning tool

Table I—Production Data for Deep Hole Drill-Type 1

Diameter	0.234	0.297	0.394	0.590	0.760
Feed, ipm	1.655	1.812	1.655	1.180	0.985
Oil Pressure, psi	500-570	500	430	350	280
Average length drilled before redressing *(in.)	180	950	430	315	1300
Average total life of drill*	328-2300 feet				

*NOTE: Varies with material and tolerance.

or core drill head. This is the deep hole drill—Type 3. Experiments are presently being conducted to determine the smallest diameter hole which can be economically drilled using the trepanning principle. There is that point where the Type 2 drill offers greater advantage for the smaller diameter holes. We have successfully trepanned holes under one inch in diameter although complete data are not yet available for publication. It can be said that for drilling deep holes of about 2 in. in diameter or larger, the Type 3 drill is the proper tool to employ.

Prototype tools employing the trepanning technique are shown in Figs. 5A and 5B. In these earlier trepanning tools the drill bars were profiled as in deep hole drill—Type 1. The coolant was fed through the center of the drill bar and the chips flowed to the rear in the chip passages between the inside wall of the drilled hole and the wall of the drill bar. Disadvantages of these earlier trepanning tools were the lack of control of the drill head to reduce vibration and the fact that the chips were allowed to come into contact with the drilled hole. The tungsten carbide cutters were provided with the chip-breaker feature to form small chips. After using the two-cutter tool head as in Fig. 5A, the one-cutter tool head was designed as in Fig. 5B. The single-cutter head performed at higher feeds than the two-cutter head. However, in both cases, the life of the tungsten carbide cutters was short due to the inability to reduce vibration.

Fig. 6 shows the latest patented trepanning tool and therein can be seen the general arrangement of the workpiece, the trepanning tool head, the tool head tubular carrier, the oil feed apparatus and the course of the coolant and chips. The oil feed apparatus follows the same principles of operation

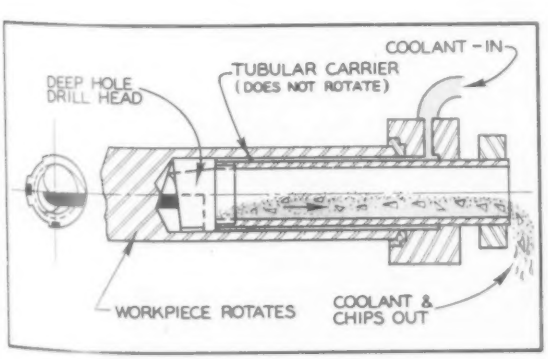
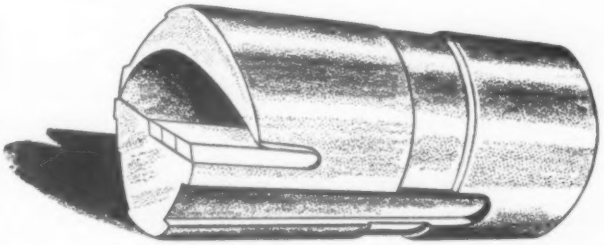


Fig. 3A (left) pictures ordinary arrangement of Type 2 deep hole drill which has a replaceable drilling head and a tubular instead of profile bar. Below, 3B gives closer view of drillhead.



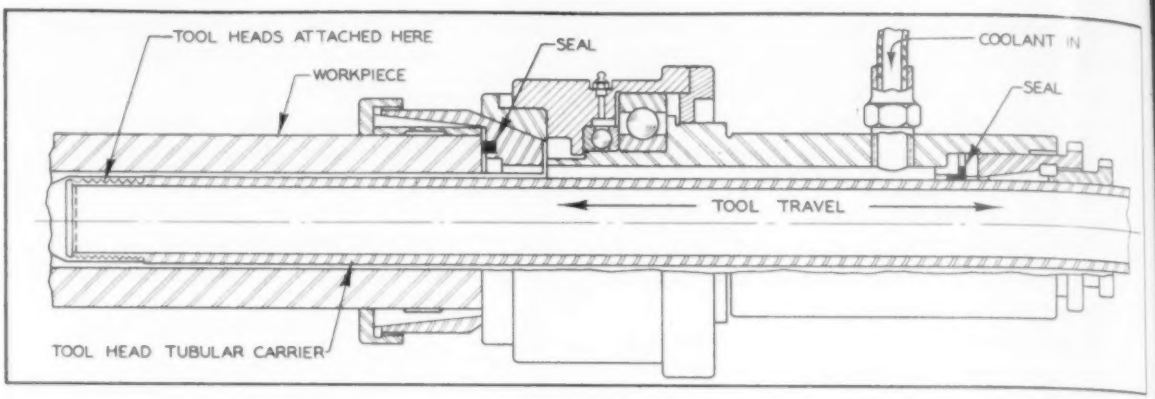


Fig. 4. Sketch of the usual arrangement for deep hole shaving tool presents clearly the arrangement of the oil feed apparatus. Note particularly how seal for the coolant system is insured through construction of the unit.

as found under deep hole drill—Type 2 (Fig. 3). The extraordinary high production rate of this trepanning tool is due to the small volume of chips produced, allowing the chips to pass between the core and the inside wall of the tubular carrier. Further, the accuracy of the drilled hole can now be held to close limits while still maintaining concentricity throughout the length of the drilled hole. The elimination of vibration, which is controlled in a manner as shown in Fig. 3, allows the use of a grade of tungsten carbide which gives greater tool life.

Perhaps the easiest way to describe the operation called trepanning, is to compare it to the coring of an apple. The tool is inserted and when withdrawn the core is withdrawn. It is to be noted that with the Wohlfahrt trepanning technique, the core which is trepanned is supported in such a manner that the trepanning tool can pass through the entire length of the workpiece. Earlier forms of trepanning would allow the tool to progress within the work just short of the end, then be withdrawn. The workpiece was cut off at the far end, allowing the core to fall free. If the trepanning tool head were allowed to pass through the workpiece in the older methods, the core would drop at the instant the furthermost end of the cutter passed through the workpiece, causing irreparable damage to the cutter head.

There apparently exists no limit to the size of hole that can be trepanned with this system. As opposed to older forms of drilling, the rate of feed in trepanning is proportionate to the diameter, as can be seen in Fig. 1. This increase in rate of feed as the diameter of the cored hole is increased is realized from a pressure curve for a conventional twist drill. The pressure on the tool increases from the OD of the drill to an infinite pressure at the geometric center. Thus, the further the cutting edge of the tool can be placed from the center of the workpiece the less power is required to trepan. We have been able to increase the feed up to 11 inches per minute (55 ft per hour) for the larger diameter cored holes. We have trepanned a $2\frac{3}{4}$ in. hole, 39 ft long, in 20 minutes. With conventional methods of drilling, several hours would have been required to perform this operation and the accuracy of the diameter and concentricity would not have been to the close limits of the trepanning system. In many cases, trepanning precludes the repeated boring operations which formerly were required to correct for bore concentricity.

The Wohlfahrt trepanning operation considers the following characteristics:

1. No vibration of the tool or the work piece
2. Higher rate of feed
3. Less tungsten carbide required to build the tool
4. Longer life of the tungsten carbide
5. Lower coolant pressure than used in deep hole drill—Type 2
6. The ease with which the tool head may be changed
7. Long life of the tool head tubular carrier

A typical example of a part trepanned with the Wohlfahrt trepanning tool is as follows:

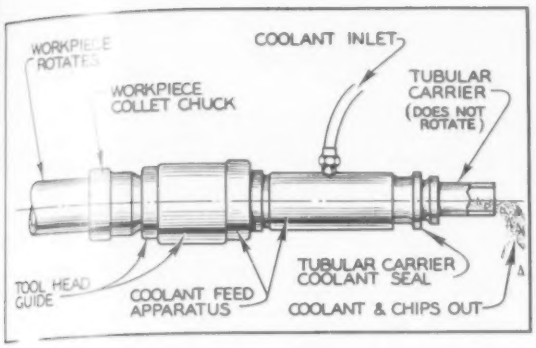
Workpiece	23 in. length
Bore Diameter	$3\frac{5}{32}$ in.
Feed	$8\frac{7}{64}$ in. per min

In determining the rate of consumption of the tungsten carbide tool, a sample piece 40 in. long was taken and the feed was changed from 40 ft per hour to 50 ft per hour. It was found that the consumption of the tungsten carbide was reduced

Table II—Production Data for Deep Hole Drill—Type 2

Diameter, in.	0.82	0.867	1.42	1.97	2.36	2.766
Feed, ipm.	3.54	3.54	4.48	5.28	7.08	7.87
Oil Pressure, psi	285	250	170	112	85	85
Average length drilled before redressing (ft)*	33-50	33-50	50	64	80-100	100
Average total life of drill (ft)*	400	400	520	750	1000	1000

*NOTE: Varies with material and tolerance



Clear view of pertinent details of latest patented trepanning tool is presented in Fig. 6.

from 0.4 oz to 0.23 oz (formerly 3.5 to 5.2 oz). The consumption of coolant was similarly reduced from 0.17 gal. to 0.08 gal. We have found that 0.4 oz of tungsten carbide is used for the production of from 90 to 110 lb of chips.

Deep Hole Boring

It often becomes necessary after the workpiece has been drilled, to give the part a subsequent boring operation. This is especially true in deep hole treatment where finer finish and closer limits of concentricity are required. Further, with the advent of centrifugally cast tubes for gun barrels, certain oil equipment and the like, where drilling is not required, the need for a boring tool using the principles of the improved oil feed apparatus was apparent. The boring tool head developed for this application outwardly resembles the trepanning head and is adapted to the tubular carrier in the same manner as the deep hole drills—Types 2 & 3. The resultant tool permits boring with a tool head that is balanced hydraulically, and the chips formed are forced back through the center of the tool away from contact with the inside of the workpiece being bored. Average data on feed show that the rate of feed for this boring tool is approximately twice that shown in Fig. 1 for the deep hole drill—Type 2 for corresponding diameters up to approximately 3.5 in. diameter. For example, for a diameter of

Table III—Production Data on Shaving Operation

Diameter in Inches	.797	1.187	1.578	3.156
Feed in Inches per Minute	21	12	9.5	5
Coolant Pressure lbs per sq in.	35-430	285-550	214-285	214
Average Length Shaved before Redressing in ft*	92	66	60	33-50

*NOTE: Varies with material

2 in. the feed is 11 in. per minute. This approximate feed calculation will, of course, vary with the material being bored.

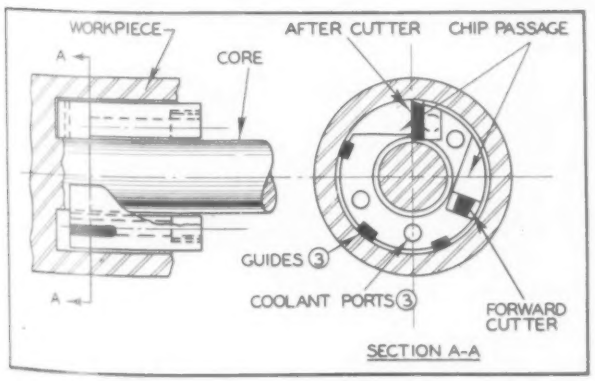
Fig. 7 shows the general arrangement for a deep hole boring tool head. It is to be noted that in most cases in deep hole treatment, where the workpiece is symmetrical, the workpiece is rotated while the tool remains stationary. However, the above principle of boring can be adapted to the boring of parts which cannot be rotated and where the tool is rotated. The control of the chips remains the same.

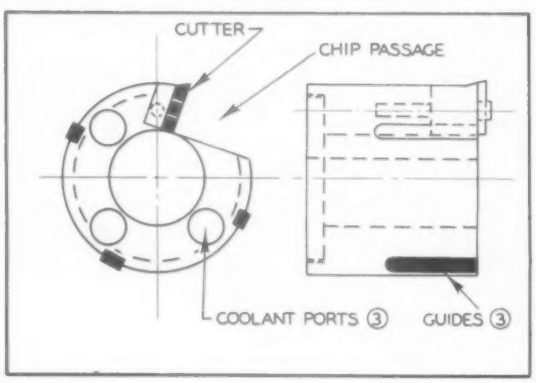
It should be pointed out that while the drawings shown in this report appear to have application in the horizontal plane, vertical machines have been designed to do trepanning, boring, etc. Vertical operations lend themselves well to multiple station machines for the handling of small diameter tubes as well as single station for the very large workpieces where the problem of proper steady-rests along the workpiece is difficult to handle. For larger work, less power is required to rotate the parts when they are positioned vertically. Further, for the larger diameters where the tungsten carbide cutter is not brazed to the tool head, a tool holder is positioned into the tool head and is given a micrometer setting for boring operations. In all cases, the tool head is easily removed from the tubular carrier.

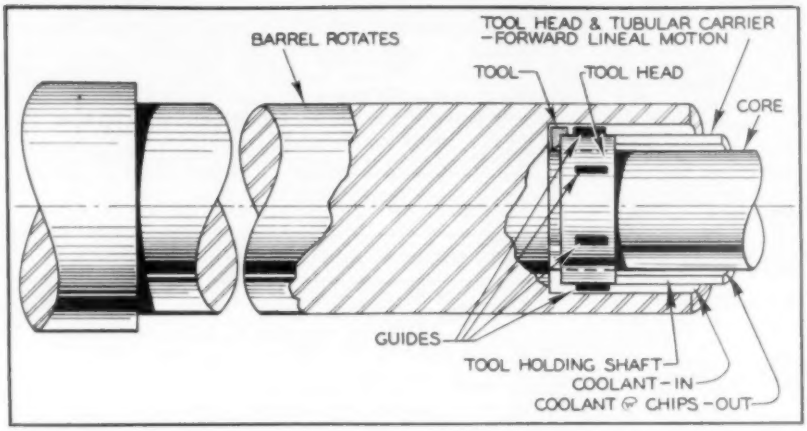
Deep Hole Shaving

Following trepanning or boring, the workpiece is placed through a shaving operation. The tool

Prototype tools using trepanning process. One-cutter tool head (Fig. 5B, right), which was designed after the two-cutter head (Fig. 5A, left), performed at higher speeds. Both lacked vibration control.







General arrangement for a deep hole boring head is demonstrated in Fig. 7, in which, when conditions require, the tool may be rotated while the workpiece remains stationary. This as opposed to the usually reversed treatment. Control of the chips remains unchanged from previous situations.

designed for this compares in use to the conventional reamer, and will shave as much as 0.015 in. stock on a side. Run-out and diameter variation have been held within 0.0002 in. and the finish is down to 50 rms. With this finish, the honing requirements of many deep hole parts have been reduced to one operation, where formerly two or more honing operations have been required. The shaving operation is accomplished with one pass of the tool through the workpiece.

Fig. 8 shows a sketch of the shaving tool, wherein can be seen the pilot guide and manner of attachment to the tubular carrier. In this case, the tool is pulled through the work (opposite in direction to all other operations discussed above). Further, the coolant is forced around the outside of the tubular carrier, through the center of the shaving tool, and then across the blades on the shaving tool. The chips and oil are forced out the forward end of the workpiece, rather than back through the tubular carrier as previously discussed with the other deep hole tools.

Table III gives average data for the shaving operation with 0.030 in. stock removed. This shaving tool head has increased the production rate 35 times over former methods. Essentially, the operation is a new machining method.

It was believed that mention of the complete treatment of deep holes should be taken up in this one discussion, in order to give the complete story of our research into this field. Further, knowing the capabilities of this complete process, one is able to determine at the outset the time of each operation, stock removal of each operation, average consumption and life of tools, coolant consumption, capacity of machines, and the like.

While all details cannot be covered in a report of this type, a thorough appreciation of the subject can be had from a discussion of a few of the prototype tools and machines to show the reasoning for adopting the present tools.

In addition to further experimentation on machine and tool design elements, data are constantly being assembled on our experiments with different grades of tungsten carbide. (In an early issue of *The Tool Engineer* a report will be presented on the tungsten carbide investigations carried on in the United States and Germany, and the data accumulated on special tungsten carbide grades.—*Editor.*)

Although we are not making it a matter of this report, we are presently working on a treatment of the deep holes which will follow the shaving operation. This new operation will, we believe, remove the necessity of honing tubes, such as gun barrels.

In January of 1951, this firm licensed the United States Government to use the entire Wohlfahrt process for the Production of gun barrels.

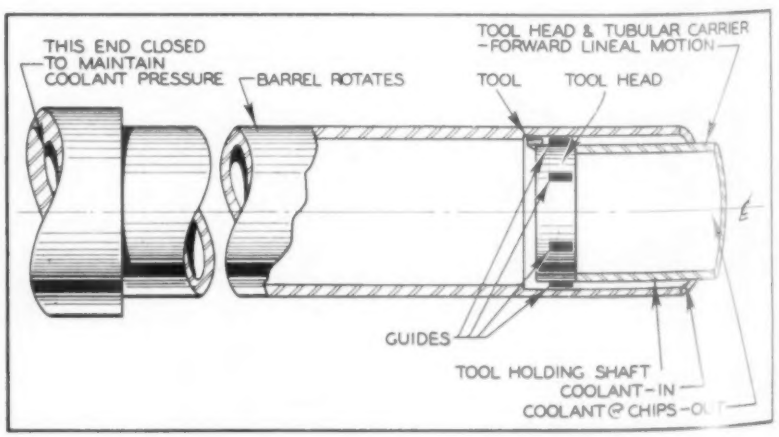


Fig. 8 pictures shaving tool in which the tool is pulled through the work. Note pilot guide and manner of attachment. Here the coolant travels around the outside of the tubular carrier, through the center of the shaving tool, across the blades of the tool. Also in reverse to previously discussed deep hole tools, chips and oil are forced out the forward end of the workpiece instead of back through the carrier.

An ASTE Service to Industry —

Clearinghouse Aimed at Alleviating Tooling and Machine Shortages

Recently announced by *The Tool Engineer* is an industrial clearinghouse service designed, said Editor Gilbert P. Muir, "to bring the resources of ASTE members the continent over to bear in our critical defense tooling program."

In setting up its clearinghouse program, it was recognized by *The Tool Engineer* that, except in a totally controlled economy, the establishment of a defense tooling program cannot be spread absolutely evenly among all the thousands of manufacturers in America. Thus, initially, there is certain to be some unbalance, in which certain companies or industries are called upon to supply tremendous demands in comparison to their normal output. Other industries, and smaller manufacturing companies may not be brought into the program at its outset and, because of materials, labor or market conditions brought about by the defense effort, are not operating at optimum capacity.

The Tool Engineers' clearinghouse service, in essence, has been created to aid both types of companies. For the manufacturer requiring assemblies, parts, contract machine work, engineering services, tools, dies or jigs and fixtures, the clearinghouse will endeavor to put him in touch with companies which have open capacity on the particular type of work needed.

To the plant with open capacity, on the other hand, it offers the opportunity to make use of productive facilities, take part in the defense tooling effort and continue with the type of production best suited to the plant and the type of production with which plant personnel are most familiar.

How it Works

Since announcement of the clearinghouse was first made, many plants in various sections of the United States and Canada have contacted *The Tool Engineer*, advising what facilities are open, and to what extent.

All industrial companies with open capacity in any phase of tooling or production are invited to list their facilities with *The Tool Engineer*. A form will be mailed, requesting specific information on personnel, plant area, security, equipment, etc., so that a prospective client will be able to evaluate the facilities in terms of his requirements.

A file is maintained in *The Tool Engineer* offices of all interested plants, classified by industry. When an inquiry is directed to the clear-

"The importance of exchange of this type of production and tooling information will be increasingly more important as our defense program swings into more advanced stages of actual production.

Engineering design changes and improvements in materials, to name two important factors, will create great pressure for new types of tooling, and this, plus the out-of-the-ordinary tooling problems that will result, require the coordinated effort of tool engineers everywhere in order for our defense effort to succeed."

—Harry E. Conrad, ASTE Executive Secretary

Some Typical Examples of Current Open Capacity:

Process engineering	Press and roll forming
Tool designing	Milling
Gear cutting	Grinding
Jet production consultation	Screw machine products
Machine design	Forming and blanking dies
Welding—arc and resistance	Stampings, small assemblies
Heavy production machining	Piercing, blanking, forming
Jigs and fixtures—design and construction	Die casting dies
	Special gages

inghouse, a list of possible suppliers is furnished the inquirer, who assumes the responsibility of selecting his supplier from the data furnished by the clearinghouse files. The list of possible suppliers furnished by *The Tool Engineer* will be based on geographical and volume requirements of the inquirer—in other words the clearinghouse will base its suggestions on the size of the inquiry and therefore the size plant necessary to fill the order.

Service is Gratis

The clearinghouse program is rendered to industry gratis. It is open to all industry and to government. From files which will be kept up-to-date, the clearinghouse will promptly furnish to any bona fide company needing subcontractors or suppliers a list of firms which are believed to be capable of handling the assignment. Naturally, we cannot undertake to make personal investigation of all firms listing their facilities with us—that must be the responsibility of the company making the inquiry. However, it is apparent that initial screening at the clearinghouse office will reduce investigating effort of the inquirer to a fraction of that required were he to search for suppliers unaided.

Who Can Make Use of the Program

The Tool Engineer clearinghouse will endeavor, within broad limits, to locate a supplier for any product or service associated with tool engineering.

One major field in which aid is needed, for example, is machine tool production. The clearinghouse solicits inquiries from machine tool builders who are making plans to subcontract machine tool sub-assemblies, and in addition solicits applications from plants with open capacity on equipment which is capable of this type of production.

To Prime Contractors, Government and Armed Forces Agencies and Other Companies requiring assemblies, tools, machines:

1. The clearinghouse will endeavor to supply any part, assembly, type of work, product or service which you might require. Some typical requirements are listed below.
2. Write, call or wire the clearinghouse at the address shown at the bottom of this box. State requirements specifically, including quantity, needed delivery date, tolerances if unusual, and type of facilities desired. If possible, and if requirement is unusual, enclose prints with inquiry.
3. The clearinghouse will promptly check its files for possible suppliers, and if source is available, will immediately forward data on companies which appear to have adequate facilities to handle inquiry. If source is not available, an attempt will be made to find one.
4. Contractor should advise clearinghouse on disposition of inquiry and approximate length of contract so that clearinghouse files may be kept current.

Some typical services

- Dies
- Special cutting tools
- Tool designing
- Machine tool construction
- Jigs and fixtures
- Castings
- Subassemblies
- Welding
- Hydraulic and pneumatic assemblies
- Forgings
- Stampings
- Grinding
- Engineering consultation
- Machining
- Drafting time
- Plating and finishing
- Metalworking equipment
- Controls

To potential subcontractors and suppliers:

1. Your application for listing of your facilities is invited. In reply to your inquiry, a memorandum will be forwarded, requesting specific data on plant, equipment, personnel, etc. This information will be kept on file at the clearinghouse, and will be made available to bona fide companies needing services or products in your normal line of work.
2. When an inquiry is received concerning an item in which you have previously stated your interest, information on your company will be forwarded to the inquirer, subject to the geographical and volume limitations established by the firm making the inquiry.
3. You will be advised by the inquirer if your plant is selected, and you will negotiate with him.
4. All types of facilities, large and small, in virtually all metalworking industries are needed. Advise us now of your facilities and the amount of open time available.
5. You will be required to keep the clearinghouse informed as to your availability as a subcontractor, in order that our recommendations to prime contractors will be current.

For further information contact Gilbert P. Muir, Editor, *The Tool Engineer*, 10700 Puritan Avenue, Detroit 21, Mich., Phone: University 4-7300

The Economics of Machine Replacement

By Everett M. Hicks

MANAGER, GRINDING MACHINE DIVISION
THE NORTON COMPANY

THE PRINCIPLES OF SCIENTIFIC management have had wide recognition in their application to time and motion study, incentives, quality control, and practically every phase of modern business practice. Oddly enough, the area of equipment policy has been neglected, and most organizations have made no improvement in the haphazard methods which were in use 50 or 100 years ago.

Modernization and cost reduction is only one of the many reasons for purchasing new equipment. Historically, most new machinery was acquired for expansion or because of alteration of requirements due to change of product design. Improvement in quality of product frequently brings with it the need for closer tolerances and better finish, which in turn dictate the need for throwing out old machines in favor of newer and more accurate models. If it were not for the influence of expansion in keeping down the average age of our productive machinery, many of our plants today would be even more obsolete, because they have generally failed to recognize the need for continuing equipment studies and replacement. This is directed primarily at the need for improved methods for locating and testing the economic desirability of modernization projects.

Current Equipment Replacement Policy

What is the present status of the equipment practices and policies of American business generally? Do most companies have an adequate equipment program? Do they have a logical and sound approach to the problems of deciding when an investment in equipment can be justified?

A recent inventory of machine tools in the United States revealed that 43 percent of the machines in use were over 10 years old. Worse still, one out of every five machine tools was more than 20 years old. The actual situation is even more critical than is revealed by these figures. Hundreds of thousands of machines which are within the "less than 10 years old" category were subjected to around-the-clock operation and extremely hard usage during the early '40's.

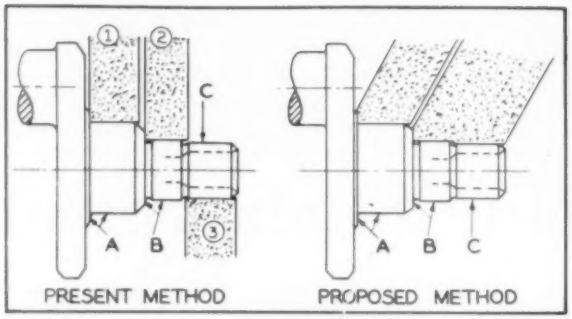
There are three main reasons for this dangerous failure to modernize continually. First, and most important, is the general use of haphazard and rule-of-thumb methods for testing proposed replacements. The second reason is false conservatism, particularly on the part of financial executives, who delude themselves into thinking that security for their enterprises lies in having a large bank account rather than investing in future earning power by purchasing modern machinery.

The third factor is found in the requirements for depreciation allowances by the Treasury Department. It is obvious that straight-line depreciation of capital goods results in depreciation charges which are too low in the early years and too high in the later years of service life. Prior to the Treasury campaign in 1934 for the reduction of depreciation charges, most businesses used the straight-line write-off but over a period somewhat shorter than the full life expectancy of the assets concerned. The present insistence of the Treasury Department on the use of long service lives forces industry to charge off depreciation at much lower rates than were formerly used, with the result that most existing assets have book values which are overstated when compared with actual capital consumption based on the historical cost of the asset.

It is significant to note that both in World War II and again recently, special amortization over a five-year period is provided to encourage expansion for the Defense effort.

Many companies have no formal policy for deciding on replacements, reaching their decisions largely on intuition and hunches which they dignify as "sound" business judgment. Where a policy does exist, it is usually one of two widely used rule-of-thumb devices: (1) the short pay-off requirement,

Presented at Annual Meeting, American Society of Tool Engineers, March 16, 1951



Procedure:
1—Grind dia. A and adj. shoulder
2—Grind dia. B and adj. shoulder
3—Grind dia. C

Stock Removal:
0.012 to 0.015 in. on diameters
Clean shoulders

Production:
144 shafts per hour from battery of 10 machines

Procedure:
Grind surfaces A, B and C simultaneously using two-wheel setup. Truing to be done automatically with Wheel Guard Truing Device.

Stock Removal:
0.012 to 0.015 in. on diameters
Clean shoulders

Production:
145 shafts per hour from battery of 10 machines

Direct Labor Savings:

	Shift	Operators	Hours	Rate per Hour	Cost per Week
Present Method:	1	10	40	$1.65	$ 660.00
	2	10	40	1.7325	693.00
					$ 1,353.00
Proposed Method:	1	5	40	1.65	330.00
	2	5	40	1.7325	346.50
					$ 676.50
				Weekly Savings	676.50
				Annual Savings (50 wks.)	$33,825.00

Fig. 1. From such data as these, analysis for machine replacement may be made.

or (2) the rate-of-return requirement. The short pay-off device requires that a machine must pay for itself over a specified period, such as two or three years or even less in some cases. The rate-of-return requirement is essentially the same device which merely stipulates that the cost saving must be at least a specified percentage of the investment involved.

Since these two devices are widely used, one might expect that they would stand up under critical examination. Such is not the case, however, since both of these devices fail when the question is asked: "How do you know what pay-off period or rate of return to prescribe?" If this is a sensible approach to the problem, there must necessarily be a sensible way of deciding on the proper pay-off period to be used in a particular case. Most companies using this device cannot explain why they selected the particular pay-off period used. Indeed, they usually fail to realize the importance of this decision. By setting this requirement too severely, a company can prevent itself from making investments in machinery which are sorely needed to protect its competitive position. Thus, while the company smugly congratulates itself that it has a large cash balance in the bank, its competitive position can be gradually eroded through failure to make investments in machinery which produce more and better products at lower cost.

When using the pay-off period device, there is no logical lower limit to the shortness of the period required. In practice, there are variations from one to six or more years, with no general appreciation of the consequences of this important decision. However, the results of a two-year pay-off are drastically different than those obtained with a four-year requirement when one considers that the savings through installation of the new machine must be twice as great for the two-year period in order to justify the investment when using this device. By setting up an unreasonable hurdle, the plant can be forced to operate machinery which is inefficient and costly until such time as these high costs and losses become high enough to pass the short pay-off period test.

George Terborgh, Research Director of the Machinery & Allied Products Institute, illustrates the fallacy of this thinking which treats as return on the replacement investment what may be in part simply relief from losses occasioned by the undue deferment of replacement.

> ". . . A corporation has a president 70 years of age who in the judgment of the directors can be retired and replaced at a net annual advantage to the company of $10,000. Someone points out, however, that if he is kept to age 75, and if he suffers in the interval the increasing decrepitude normally to be expected, the gain from replacing him at that time will be $50,000 a year, while at the age of 80 it should be substantially higher still, say $100,000. It is urged, therefore, that his retirement be deferred. The genius advancing this proposal is recognized at once as a candidate for the booby hatch, yet in principle it is no different than the rate-of-return requirement." (1)*

The failure to use logical methods of replacement analysis is not due to the fact that such methods have not been available. Until recently, however, most of the methods which have been developed have been so technical, requiring complicated mathematical calculations, that they have not been generally used. There has long existed a seemingly unbridgeable gap between good thinking and actual practice. Recently, however, some very fine work has been done in this field by the Machinery & Allied Products Institute ("MAPI"), which is an association of capital goods manufacturers. Problems of replacement have also received increasing attention from the National Machine Tool Builders' Association.

The MAPI Formula

The main problem of equipment policy is *when* to replace. Obviously all mechanical equipment must be replaced at some time, and it is usually not difficult to reach a decision as to what kind of equipment should be purchased. The main question

*Numbers in parenthesis refer to references.

then, is: "When does it pay to replace a machine which we now own with a new one which will do the job better?" Errors in timing can be very expensive. If the method used for testing replacements is prejudiced unnecessarily against the purchase of new equipment, and this is usually true of methods in use today, the purchase of the new equipment may be deferred for many years beyond the time when it should properly be acquired. As a result, a manufacturer will continue to incur unnecessarily high costs while waiting for his operating costs to become high enough to pass the test. Conversely, it is possible to replace equipment too soon and thus incur avoidable costs.

All machinery is subject to wear and tear and usually to obsolescence as the years pass; this is equally true of any new machine purchased. A gap will open between the operating performance of any machine in service and the performance which can be obtained from the best new machine obtainable. This gap may be due to the wearing out of the machine with use, or to the improvement in design of future machines which can be expected. This difference in operating performance between a machine in actual use and the best available replacement machine that can be bought, is called "Operating Inferiority". In replacement analysis we are faced with a choice: (a) the old machine may be retained, keeping down the capital cost and accepting higher operating cost; or (b) the present machine may be replaced, obtaining mechanical perfection for the moment, but at the expense of an increase in capital cost.

Here is the key to correct equipment policy. To reach a correct decision, when considering new machines to take the place of old, the sum of operating inferiority and capital cost for the present equipment must be compared with that of the proposed equipment, and the decision will be in favor of that equipment which gives us the smaller total of inferiority and capital cost.

Determining the "Adverse Minimum"

The purpose of the MAPI formula is to enable the determining and comparing of these totals of inferiority and capital cost for both the present and proposed machines. For ease of reference these totals have been given a name, "Adverse Minimum". Replacement should be made when the total of average future inferiority and capital cost obtainable from the new machine is below that obtainable from further use of the old one.

In the case of the present equipment, the Adverse Minimum is obtained by first calculating the savings which can be expected next year if the new machine is installed. This is the Operating Inferiority of the present equipment compared with the new. To this is added the capital cost of retaining the old equipment, and the total is the Adverse Minimum itself.

In finding the Adverse Minimum of the proposed equipment, it must be recognized that, if installed, it will gradually accumulate inferiority in the years ahead as it deteriorates in service and as new and improved machines become available. While the exact amount of this inferiority, year by year cannot be foreseen, it can safely be assumed for purposes of the replacement study that the inferiority will occur at a constant rate over the service life of the proposed new equipment. The MAPI formula assumes that this inferiority will occur at a constant rate which will make it replaceable at the end of its estimated service life by some other new machine. This simplifying assumption has made it possible to develop a chart which permits figuring the Adverse Minimum of the proposed equipment directly, which is a very easy matter. All that is required is to estimate the service life of the proposed equipment and the salvage value, if any, at the end of that service life.

Application of the MAPI Formula

Fig. 2 shows one case worked out on an equipment replacement analysis form which was developed and used by Norton Company. The information on Lines 1 to 5 is entered from the data shown in Fig. 1. Lines 6 through 12 show the calculation of the Adverse Minimums for the present and proposed equipment respectively, and on Line 12 is shown the Gain from Replacement for the first year. Before this section can be discussed, it is necessary

Fig. 2 shows typical analysis study sheet.

NORTON COMPANY
EQUIPMENT REPLACEMENT ANALYSIS

Date 1/29/51

	PRESENT	PROPOSED
1 Description	10-Plain Cylindrical Grinders (various sizes with single wheels)	5-10 x 36" Semiautomatic Grinders (Angular Wheel Slide with 2 wheels)
2 Gross price (scrap value)	x 1,300	($25,812 ea.) x129,060
3 Age (average)	28 yrs	15 yrs
4 Estimated Remaining Life		x 2,500
5 Investment Required		2 %
6 Annual operating cost	x43,486	x129,060
7 Less annual tax saving	---	10 %
8 Income annual taxes	130	10 %
9 Provision capital additions	---	20 %
10 Income capital additions	---	
11 Annual operating cost	x43,616	x 25,812
12 Gain from Replacement	x 17,804	

OPERATING ADVANTAGE (next year)

13 Income Adjustments			---
14 Depreciation of product			---
15 Increased sales			---
16 Other			---
17 Tax Adjustments			
18 Other taxes			33,825
19 Interest taxes			---
20 Income taxes (saved) 20 %			6,765
21 Maintenance			2,500
22 Supplies			
23 Power			
24 Insurance			
25 Space Costs			
26 Other items (375 sq. ft. @ 8.50)			187
27 Power			1,500
28 Property taxes and insurance (@ 1%)		1,291	
29 Other			
30		1,291	x 44,777
31 Net Operating Advantage (1 - 2)			x43,486

Remarks: Replacement looks obvious.

Recommendation: Replace at once

Signed: John W. Smith — Approved: Frank S. Jones

Date: 2/1/51 — Date: 2/1/51

to calculate the operating advantage of the proposed equipment next year, which is done on Lines 13 through 29. The amount of these savings must be determined because this gives the operating inferiority of the present equipment, which is the first step in finding the Adverse Minimum of the present machines.

In Fig. 2, that part of the form which is used for estimating the operating advantage is essentially the same as forms which are generally used to calculate the savings which can be obtained from new equipment.

Under present practices, a great many replacement analysis are decided solely on the direct labor saving involved. While this is usually the most important single factor, there are a great many cases where other benefits than direct labor savings are extremely important and may swing the balance in favor of replacement.

The data in the case example shown in Fig. 1 has been taken from records of a recent sale involving a battery of five new machines for grinding bearings of an automotive crankshaft. As indicated, the new machines will mount two wheels each, feeding at an angle, so that three diameters and two shoulders can be ground simultaneously. Previously this operation required the crank to be handled in and out of three different grinding machines, a total of ten machines being necessary for the operation.

Normal plant operation calls for two 40-hour shifts, and the savings to be expected from the new equipment are figured on that basis. The detail of the calculation of direct labor savings is shown in Fig. 1, and this total is entered on Line 16 of Fig. 2 in the amount of $33,825. In this case, this represents the direct labor savings of five operators on each of two shifts.

No allowance for indirect labor savings is included, although in many cases reduction in direct labor will be accompanied by savings in supervision, floor men, and other items. Fringe benefits, including such items as group pension and insurance costs, social security, paid vacations and holidays, are estimated at 20 percent of the payroll, so a figure of $6,765 is entered on Line 18, which is 20 percent of the amount shown on Line 16. The company estimates that it costs $400 each per year to maintain the 10 old machines, while upkeep of the 5 new machines is expected to cost $300 each per year, resulting in a maintenance saving for the first year of $2500. No savings have been claimed for supplies, tools, spoilage or down-time because, in this case, the replacement decision is overwhelmingly indicated.

The new installation occupies 375 less sq ft of floor space which, at a value of $0.50 per sq ft, results in a saving of $187. Decreases in floor space should only be recognized in a replacement analysis when it is expected that this area will be needed for other purposes.

There will be a total of 50 less horsepower required by the 5 new machines, and it is estimated that this will result in annual power saving of $1500.

Property taxes and insurance amount to one percent of the value of the new equipment, so we have entered on Line 26 $1291 as an advantage for the present equipment which, because of its age, has been entirely written off the books. On Line 28 the advantages of the present and proposed equipment are totaled. Subtracting $1291, the advantage for the present, from $44,777, the advantage of the proposed, gives a net operating advantage of $43,486, which is entered on Line 29 and is also transferred to Line 6.

Calculating the Adverse Minimum

The Adverse Minimum of the present machines can now be calculated. The net Operating Advantage of the new machines is the same as the Operating Inferiority of the present machines. It remains only to calculate the capital cost of retaining the present machines one more year in order to obtain their Adverse Minimum, or sum of their operating inferiority and capital cost.

In this case, the ten present machines are so old that they must be scrapped, and they will be worth approximately $1300 as scrap. This is the value shown on Line 2 of Fig. 2. If these machines had a re-sale value, it would be determined what could be obtained from them now and an estimate made of what they probably would be worth a year from now, and the difference entered on Line 7 as the Loss in Salvage Value. Since they would still have scrap value a year hence, nothing is taken on Line 7 in this example. If it is decided to keep the present machines another year, the $1300 in cash will be passed up which could be obtained if they were sold now. Therefore, it is only reasonable to charge interest on this $1300 as a part of the capital cost if it were decided not to replace. For purposes of this example an interest rate of 10 percent is used; therefore, an amount of $130 is entered on Line 8 for interest. Adding the figures on Lines 6 and 8, a total of $43,616 is obtained as the Adverse Minimum for the present machines, as compared with the proposed replacement machines under consideration.

Lines 9 and 10 have been included on the form for purposes of completeness and they require a brief explanation. These lines are used only when a major expenditure is required to keep the present machines in service. Since this capital addition may extend the life of the machine for more than one year, it is obviously improper to charge it in full

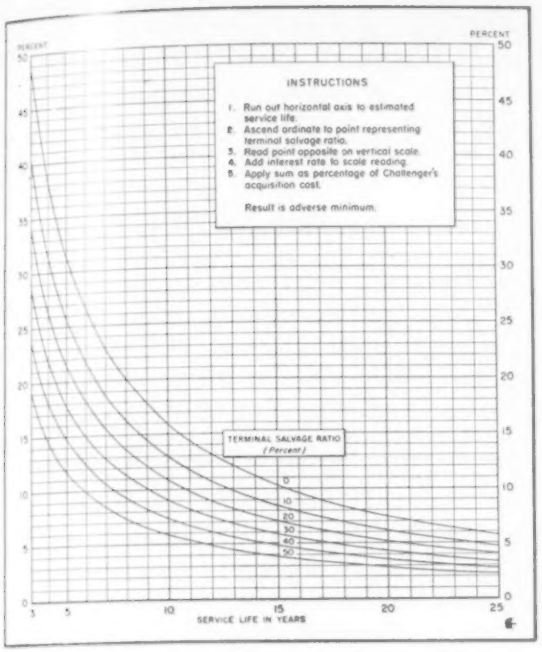


Fig. 3. Chart for deriving Challenger's Adverse Minimum by the MAPI formula.

against next year alone. This is handled by dividing the amount of the expenditure by the number of years of extended life to obtain the amount chargeable against next year. Thus, for example, if a major overhaul costing $2000 is needed and the extended life is expected to be four years, $500 would be entered on Line 9. Since this $2000 expenditure must be made now, and in cash, interest on the full $2000 would be charged on Line 10 which, at a rate of 10 percent, would amount to $200.

We are now ready to calculate the Adverse Minimum of the proposed equipment purchase. On Line 2 the Cost Installed of the proposed machines is shown as $129,060. This figure is based on the supplier's quotation plus an estimate of the delivery and installation costs. It is estimated that the new machines will have a service life of 15 years. This is the length of time these machines will be expected to continue on the job before some new machines will be able to replace them. It should be stressed that this service life is not the physical life of the machine, which may be longer, nor has it any necessary relation to the life used for tax depreciation. After the machine has been replaced, it may survive in other service, or be sold and continued in use under other ownership.

Fig. 3 is the MAPI Chart used for determining the Adverse Minimum of the proposed machine. This chart is constructed on the assumption that the proposed machine will acquire inferiority through future deterioration and obsolescence at a rate which will make it replaceable at the end of its estimated service life.

The first step is to determine the Salvage Ratio, which is shown on Line 5 of Fig. 2 as 2 percent. This is calculated by dividing the estimated salvage value of the proposed machine at the end of its service life by its installed cost. In the case being discussed, this value is $2,500 ÷ $129,060, or 2 percent. All the information is now at hand that is needed to use the MAPI chart, Fig. 3. The heavy black curved lines on the Chart are the salvage ratios, which in this case are determined to be 2 percent. The curved lines show various values for salvage ratios from 0 to 50 percent. Running along the bottom of the chart horizontally to the service life of 15 years, we then ascend this vertical line to a point representing our terminal salvage ratio of 2 percent. The point opposite on the vertical scale at the left is read as 10 percent. This is entered on Line 7 of Fig. 2. The interest rate of 10 percent is entered on Line 8, giving a total of 20 percent, which is entered on Line 9. Applying this 20 percent to the installed cost of $129,060, gives the Adverse Minimum for the proposed machines of $25,812 which is entered at the right on Line 11.

Subtracting the Adverse Minimum of $25,812 for the proposed equipment from the $43,616 for the present equipment, the difference of $17,804, entered on Line 12, is the "Gain from Replacement—Next Year". This gain from replacement is after the cost of capital has been charged against both the present and proposed installations. In this case the advantage of the proposed equipment is overwhelmingly clear and the decision is to purchase. Probably this decision should have been reached some years ago.

It might be asked how much of a gain is required in order to justify the purchase of the new equipment. Since it can be expected that the operating inferiority of the present machine will continue to increase with the passage of time faster than its capital cost will decrease, it is almost certain that the Adverse Minimum for the present machine is as low now as it ever will be and that it will continue to increase. Therefore, if the Adverse Minimum of the present and proposed equipment should prove to be equal in size, replacement is probably indicated.

One word of caution should be injected, however. The conclusions derived by this formula and by all other formulas are based on estimates. If the results obtained do not show clearly a distinct advantage in one direction or the other, it is advisable to review the estimates which have been made in order to be sure they are reasonable. It is at this point that sound judgment is needed in arriving at a positive recommendation.

References

(1) *MAPI Replacement Manual*, p. 6, Machinery & Allied Products Institute, 1950.
(2) Terborgh, G., *Dynamic Equipment Policy*, McGraw-Hill Book Co., Inc., 1949.

Designing and Pattern Dies For Investment Casting

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PART II

THE POTENTIALS OF PATTERN die design are considerable. For example, the accuracy obtainable is illustrated by a 49-section die used to make waxes for a radar wave guide casting. The part formerly was an expensive assembly produced by furnace brazing more than 20 components. The economic advantage is indicated by the fact that the finished cast part costs about $75, of which about $30 is the foundry cost, where the finished assembly formerly cost over $350 per piece. The aluminum alloy used, type 356 T 6, could not be satisfactorily die cast. Parallelism held in the rectangular channels is within plus/minus 0.002 in., and the angular relationship of the cross channel is held to a few seconds of arc. Where draw cores must function to such close tolerances, production of the casting directly from molten metal is obviously impossible. Construction and operation of a complex die, such as this, for die casting molten alloys is impossible.

The wax pattern die for the steel numbering wheel casting contains 54 pieces. Many of these are located in the main die body. The twenty slides used to form the 10 raised and 10 sunken numbers are closely ground and fitted to retain concentricity, to operate freely and to avoid distortion of the 0.025 in. high fine numerals. The concentricity is held in the casting to within 0.002 in. plus or minus on a 1.388 in. dimension. The arrangement of cams and springs used to advance and retract the slide bars would be impossible in a die intended to receive molten metal. The unit casting replaces an assembly of 5 components. The finished casting price is less than half the former cost of engraving the numbers.

Not all complex designs require complex dies. The widely-known 356 T 6 aluminum full impeller casting would be costly to machine and cannot be die cast because of metallurgical and mechanical factors. The die body is made of Cerrotru. The two cores are mounted on steel plates and are made of carbon steel. The quantities of patterns required are such that ordinarily a steel die would be used. However the cost of introducing the intricate curves of the impeller to a steel die would be excessive, therefore it has been found most satisfactory to reform the soft metal die segments from the original master pattern whenever wear becomes excessive.

The impeller casting is too large and too intricate to warrant production through a multiple cavity die. The problem of freezing a gang of impeller waxes without distortion from a 2 or 3 cavity die exceeds the possible benefit of multiple pattern production. The substitution of a multiple cavity die for a single cavity must be therefore governed by size and intricacy of the pattern as well as the volume required.

Small Parts Suggest Multiple Cavity Die

Where the parts are small and comparatively simple it is usually desirable to make a multiple cavity die, even though as few as 10,000 patterns may be required. The change from a single to a multiple cavity die which produces a complete sprue of patterns is so advantageous in producing the patterns that the casting price may be reduced by as much as 50 percent or more. The design and location of the runner and gates to the multiple patterns is the prime controlling factor which will justify or defeat the use of the multiple cavity die to replace a single cavity die.

This arises from the fact that the main economy of conversion comes from the elimination of manual gating and spruing of the small patterns. Where the runner connects 10 or 20 small waxes the advantage is very pronounced because not only is there the time gain in producing 10 or 20 units at a single injection, there is the elimination of the time required to assemble the patterns to their gates and runners to form the completed sprue of patterns. Furthermore there is a definite economy in the avoidance of broken, warped or otherwise damaged patterns which can result when the waxes are sub-

jected to individual manipulation. The runner used to fill the die with wax or plastic must be adequate to serve as a means of ejecting and handling the attached patterns. The runner and gates must be sized to serve as the pattern for the channels to admit the melted alloys to the investment mold cavities during the casting operation.

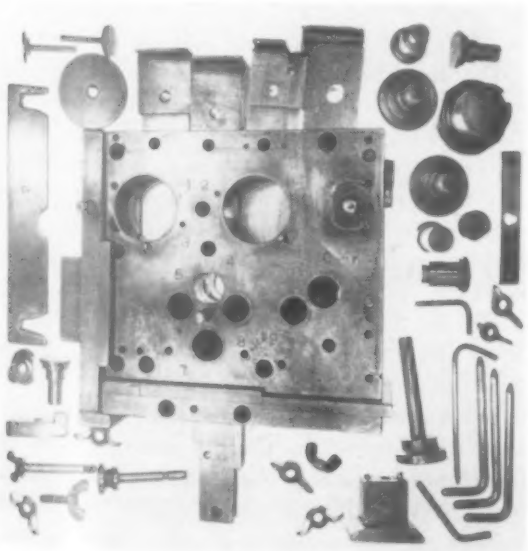
The injection gate is usually introduced along the parting line. In rare instances the pattern may be injected through gates contained in specially designed cores, where no suitable place along the parting line may be gated. In multi-parting dies the gate may be located in one or more planes as necessary to fill the heavy sections in the casting. Each heavy section must be gated if it is to be held to dimension and to be free of solidification cavitation. The gate should be located on a non-critical surface when consistent with the requirements for filling and feeding the heavy sections. If this is not possible the gate area must be machine finished when close tolerances are required.

Castings which contain several separated heavy sections must either have the sections so grouped that they may each be gated or they must be redesigned to equalize the section thicknesses which cannot be gated. If this is not done the patterns will be off-dimension in the ungated sections due to shrinkage of the wax or plastic. Further loss of dimension will be encountered by further shrinkages encountered in the solidifying and cooling casting.

Location of the parting line or lines in the pattern die is the most important single control factor which will govern the reproducible accuracy of the patterns and resulting castings. The tool designer should try to locate the parting lines in non-critical surfaces. Even though no parting line exists in the investment mold, the image of the parting line in the die is reproduced on the casting to the extent that it appears on the pattern. It is usually not possible to hold the pattern or casting tolerance to less than 0.010 in. in the area of the parting line and in the area of the gate. Where the parting is in a non-critical edge or surface it may be blended away either in the pattern or on the casting. The ability to make this correction in effect prolongs the pattern die life because otherwise objectionable flashing, due to wear of the die, may be removed from the parts if the surfaces affected are not held to minimum as cast tolerances.

The parting line governs the location and size of the injection sprue. These are doubly important. They not only control the precision of the patterns and castings but where the injection sprue becomes the gate for admission of metal to the mold cavity, the density of the casting is governed thereby.

Fig. 6. The partially assembled radar pattern die shows the major cores in their approximate alignment.



Drafting Requirements Vary

Requirements for drafting the sides of a pattern die vary with the foundry practices and the pattern-making techniques in different foundries. For most parts it is not necessary to allow draft. It is essential that no negative draft exist on surfaces of master patterns which must be retracted from soft metal sections in the process of manufacturing the soft metal die. It is equally essential that no reverse draft exist in perpendicular or straight parallel surfaces in the die cavity because in both cases removal of the master pattern or the wax pattern will be prohibitive. Some investment foundries require ½ deg of draft to facilitate removal of waxes; these shops usually attempt to avoid multiparting dies in the interest of maximum speed of pattern production. However where draft will interfere with the desired functional tolerances of the intended casting it is far better to make a multi-sectioned die and produce more accurate patterns and castings. Multiple parting dies afford an easy method for producing intricately detailed patterns involving necessary reverse drafts, undercuts, detailed areas not readily cored, etc. Free use of multiple section pattern dies is in fact the only way to begin to realize the potential design advantages of investment casting.

In the plastic pattern die it usually is necessary to locate all cores in or perpendicular to the single parting line. This is due to the difficulty of drawing cores located in other planes when the plastic pattern die block is fastened in the usual commercial injector. As most wax pattern dies are manually operated the location of cores is unrestricted. All surfaces of the die are equally accessible. There is negligible difficulty in locating cores with any necessary orientation in respect to the pattern. Most cores are drawn on a straight path. Curved cores which involve uniform rates of curvature based on

Table I—Variable Affecting Calculation of Pattern Die Dimensions.

1) Shrinkage of the alloy to be cast to make a soft metal die:
   a) pouring temperature of the die alloy;
   b) effective pressure applied to each solidifying die section;
   c) duration of application of pressure;
   d) uniformity of composition of die alloy;

2) Shrinkage of the pattern material during solidification in the die and cooling after ejection from the die:
   a) temperature of the die during injection of pattern;
   b) pressure used to inject or fill pattern die;
   c) time of "dwell" under pressure while pattern solidifies;
   d) temperature of the pattern material upon injection;
   e) temperature of the pattern upon ejection from the die;
   f) technique of ejection of pattern from die;
   g) technique of gating and clustering patterns in flask;
   h) finishing of patterns and assemblies prior to investing;
   i) temperature of the patterns during investing;

3) Shrinkages and expansions encountered in setting and firing of investment molds:
   a) proportion of investment components must be uniform;
   b) ratio of dry investment to water or other fluids must be uniform;
   c) temperature of investment during application to patterns;
   d) temperature of investment during setting out;
   e) rate of heating to extract patterns;
   f) cycle of firing to expel moisture and bring to casting heat;
   g) composition of oven atmosphere during burnout of pattern residue;
   h) cycle of cooling, when needed, to proper casting temperature;

4) Shrinkages encountered in cooling and solidification of the casting in the investment mold:
   a) pouring temperature of metal;
   b) mold cavity temperatures during pouring and solidification;
   c) composition of the alloy being cast;
   d) absence of gases, slags, drosses and other impurities;
   e) true fluidity of the alloy being cast;
   f) degree of reaction between metal and investment;
   g) use and control of inhibitors in mold or mold cavities;
   h) proportion of free metal to cored metal mass;
   i) effects of casting methods employed: (I) speed of centrifuge when employed; (II) absolute pressure differential when pressure or suction cast; (III) hydrostatic head when gravity cast; (IV) rate of pour; (V) permeability of the investment mold.

NOTE: All of these variables may be controlled to a greater or lesser degree depending upon the economic justification for varying degrees of exactitude. Present metallurgical equipment limits control of the melting and casting environmental gases and their effects on metallurgical uniformity. To the extent that conditions may be standardized, the precision of casting is capable of control. Deviations from the norms of operation are instantly reflected in the size of the castings; some variations causing larger others smaller parts than normal.

conic section functions may be used and retracted with suitably curved guides.

Accuracy of the pattern die must be greater than is required in the casting because in the normal course of foundry processing there will be fluctuation of actual casting tolerances above and below the nominal dimensions imparted to the patterns by the die. Master patterns must be designed with provision for four different shrinkage or expansion factors. The cavity being machined into a steel die need be compensated for but three of these same factors. These and the most obvious details which govern them are listed in Table I.

Effects of the shrinkage of the various soft metal die alloys are understood and cause little difficulty in producing accurate soft metal dies. The surface finish of the master pattern is very important in helping to produce an accurate soft metal die which has a good finish. The process of investment casting tends to intensify surface defects which exist in the patterns as imparted by the pattern dies. The pattern will be as rough as the die, but the castings will be rougher. It is essential that all finish lines which cross the direction of ejection of the pattern from the die be erased. On non-drafted masters which involve a fairly deep draw the presence of superficial scratches contrary to the direction of draw may lock the master into the cavity. In any case such lines will inhibit ejection of patterns and cause considerable distortion and loss of production time. The smoother the master pattern and the resulting pattern die cavity the better the patterns will be and the more uniform the required cast parts will be.

The shrinkages encountered in casting metal into hot investment flasks are not so readily established and controlled. Each alloy or each family of alloys has a solidification shrinkage factor which differs somewhat from all others. Even in processing the same alloy for a variety of casting designs the net shrinkage will be found to differ as the masses and section details vary. Uniformly thin castings must be cast at higher mold and metal temperatures to insure proper fill. They therefore shrink more than thick-sectioned castings which may be poured with colder materials. Castings which involve both thick and thin sections are particularly difficult to cast accurately for numerous reasons, not the least of which is the fact that high temperatures must be employed to fill the thin sections, thereby intensifying the shrinkage tendencies in the thick portions. The location and proportion of cores to metal sections measurably modifies the shrinkage in different areas of a single casting.

In spite of the variables, present commercial tolerances for castings of copper, aluminum or magnesium base alloys are quoted with a plus/minus 0.002 in./in. or fraction tolerance. Steel and refractory alloy castings are held to plus/minus 0.005 in./in. or fraction tolerance. In practice, if the part is well designed for investment founding and a good fluid alloy is employed, if the foundry is allowed reasonable freedom on non-critical tolerances, the limits of one or two important dimensions may be held closer than nominal commercial limits.

The high degree of design and production skill required for production of good pattern dies does not make them too costly. The small metal masses involved in most pattern dies make it comparatively easy to fabricate them to close tolerances. Use of either low temperature castable soft metals or free cutting ferrous or non-ferrous alloys simplifies construction of highly accurate pattern dies. Even though the die maker is obliged to calculate the die cavity dimensions with provision for the process variables which will be encountered in the foundry, he is required to allow most of the permissible size deviation range to the foundry end of production. Therefore, if a casting is specified to a plus/minus 0.002 in. size, the die maker will be required to produce a tool to within plus/minus 0.0002 in.

Problems In Lamination Low-Cost Tooling

By John Starr

INEXPENSIVE MOLDS OR DIES of a type recently developed at Glenwood Manufacturing Company of Burbank, Calif., can now be used for the production lamination of numerous products or parts comprising layers of metals, veneers, fabrics, plastics, leathers, and other materials which are available in sheet form.

Such tooling, briefly, consists of built-up wood parts, shielded with sheet-metal electrodes. High-frequency electronic energy can then be used to mold or cure adhesively-coated sheet materials which are stacked between and compressed by each pair of the subject tooling mates. (Where the shape of a product makes it possible to laminate materials with a single wood form block, the material might be stacked between a pair of sheet-metal electrodes.)

Standard Tools Handle Assemblies

The basic wood forms are fabricated and assembled with standard tools in a more or less conventional manner, depending on the size and shape required for each die. No special reinforcements are required as a rule, because good wood assemblies have more than enough strength to withstand molding pressures which normally range from about 25 to 150 psi. However, layers of asbestos and Silicone rubber have been "sandwiched" over the die faces by the sheet-metal electrodes to equalize pressures. This safeguard also prevented heat damage to the wood assemblies where molding temperatures exceeding 200 deg F were required

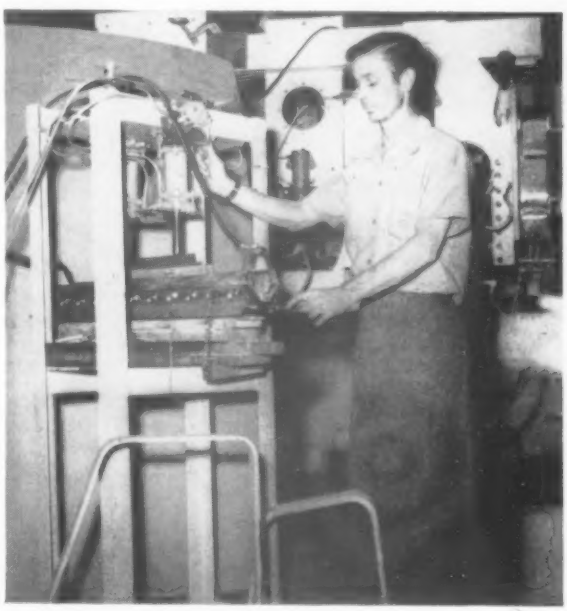


Fig. 1. Eighteen hydraulic presses of the type shown here, powered by aircraft-type cylinders, are simultaneously operated with a single pump in production work at Glenwood Mfg. Co.

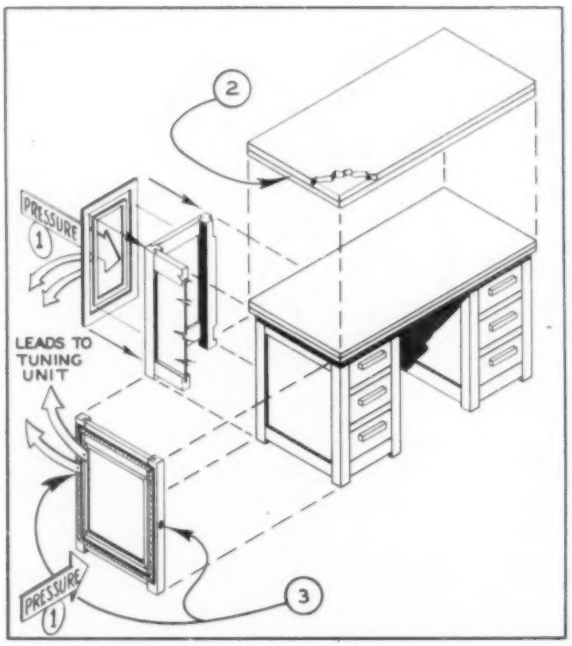
for the rapid curing of thermosetting adhesives.

Thin copper, aluminum, and steel alloy sheets are smoothly stretched over the outer die surfaces for use as electrodes with the required release characteristics. As heretofore suggested, no mating tools are required where the contours of a laminate are simple and symmetrical because pressure can then be applied to materials stacked on an electrode for a single form block or die by using conventional fixture clamps to stretch a second sheet-metal electrode over the materials.

Electrodes Facilitate Efficient Heat Guidance

The two electrodes for each lamination operation are, of course, attached to the output terminals of an electronic amplifier. Purpose of which is to transform, rectify, and oscillate the alternating current of a factory power line. The output frequency of the amplifier is then "tuned" (much the same as a radio set is tuned) so that heat energy will be projected through the lamination materials between the electrodes with maximum efficiency (according to the resonance properties of the materials).

Fig. 3. Indicated here are methods whereby a variation of the high-frequency lamination technique has been used to assemble furniture with thermosetting adhesives. At points *1*, pressure is brought against electrodes to maintain them firmly against work during curing. At *2*, strip under edge of top may be cured with electrode as used for edge-banding. Clamp or other type pressure arrangement hold parts tight at points *3* in assembly while curing.



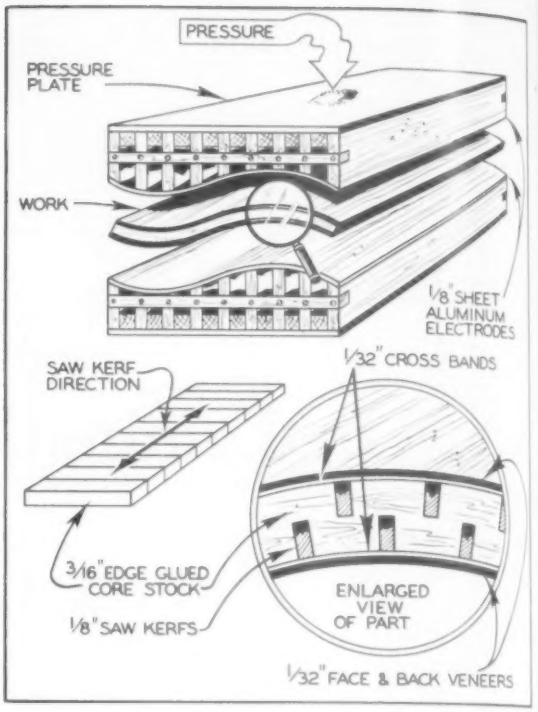


Fig. 2. Sketched here are typical metal-shielded wood dies of the kind now used in lamination work at Glenwood.

To facilitate use of the subject tooling and amplifier equipment, Glenwood tool engineers are developing a battery of eighteen presses powered with aircraft-type hydraulic cylinders so that they can be simultaneously operated via 100 ft of feed lines by a single centrallized 7½ hp, 1000 lb pump.

This in turn has made it possible to mold laminates with thicknesses exceeding ¼ in. at dimensional tolerances of plus-minus 1/64 in.

Savings Permit Handling Short Runs

Savings due to lower tooling costs have made it practical for Glenwood to handle many short production runs, which normally would be too expensive even though the cheapest cast-alloy were utilized. Where prolonged production runs were required, manufacturing costs have been reduced by an over-all margin of at least 50 percent. Durability as well as the inexpensive nature of the metal-shielded wood tools have been responsible for this result.

Incidentally, an interesting variation of the basic lamination technique as heretofore explained has been used to facilitate the assembly of wood furniture as shown in Fig. 3. It consists of using sheet-metal electrodes and clamp pressures, instead of hydraulic presses and dies, to cure adhesive coatings on mating surfaces of the furniture components with high-frequency electronic energy.

Evaluation of Protective Atmospheres for Tool Steels

By Lester F. Spencer

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Part II

DISSOCIATED AMMONIA has proven to be an adequate replacement for the hydrogen atmosphere and can be utilized for such applications as the bright annealing of the stainless steels; the bright hardening of both the high carbon and the high chromium tool steels; and the bright annealing of the high carbon steels without decarburization. The cost of this atmosphere will also vary in accordance to the quantity of ammonia that is purchased; in bulk purchases, the cost will be approximately $2.00 per M cu ft and in cylindrical standard containers, the cost may be as high as $4.00 per M cu ft. The dissociated ammonia, thoroughly cracked, will have a dew point below —60 deg F. Where dissociated ammonia is either partially or completely combusted, the cost will be lower due to the dilution factor. However, auxiliary drying units are usually necessary in order to realize a low dew point.

Charcoal Produced Atmosphere For Toolroom Work

The charcoal generator produces an atmosphere by the passage of air through a hot bed of charcoal. The incoming air burning with the charcoal at the bottom of the combustion chamber, heats the charcoal in the upper part of the container to incandescence. This converts the carbon dioxide to carbon monoxide and converts water vapor to hydrogen. The resultant gas is then filtered and travels directly to the furnace. This type of atmosphere is ideally suited for toolroom applications and affords suitable protection against both decarburization and scaling. The hopper containing the charcoal must be refilled and the tube rodded approximately every eight hours. A solution for continuous operation would consist of a generator having two tubes so that one can remain in operation while the other is rodded and filled.

The catalytic cracked atmosphere is a reducing gas produced by partial combustion of a fuel gas in the presence of a catalyst; the dew point corresponds to room temperature conditions. With the proper conditions, the resultant atmosphere would consist approximately of 19 percent carbon monoxide, 40 percent hydrogen and 40 percent nitrogen, this composition being suitable for the bright hardening of high carbon and alloy steels without decarburization. The cost of this atmosphere is between 0.15 and 0.25 cents per thousand cu ft.

Salt baths are of varying design but will be found to offer a rapid heating medium in which scale formation and 'sweat' does not form. Contrary to the opinion of many, salt baths can produce decarburization readily if the salts are not kept clean and in proper condition. Makers of salt bath equipment and chemicals can supply rectifying salts to be added at proper intervals to prevent decarburization. In case doubt regarding condition of

Table I—Chemical Composition of Test Specimens (Typical of Types that were Utilized)

Steel Type	Alloying Elements Percent							
	C	Si	Mn	Ni	V	Mo	W	Cr
A	2.20	0.50	0.50	0.50 Max	...	...	...	13.20
B	1.60	...	...	...	1.0	0.80	...	12.50
C	0.90	0.20	1.00	...	...	...	0.50	...
D	0.84	0.25	0.25	..	1.80	5.40	5.80	4.10
E	0.74	0.25	0.25	...	1.10	...	18.00	4.10

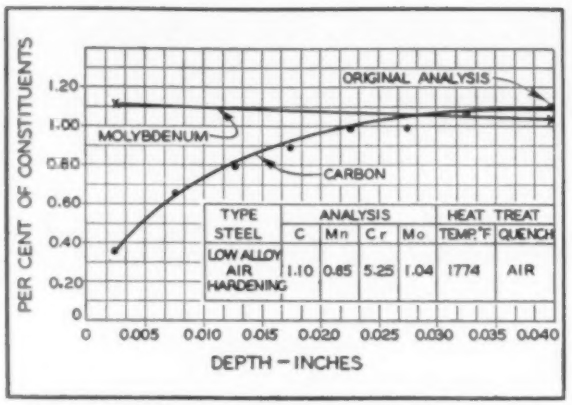


Fig. 6. Method of plotting results from data obtained from analysis of consecutive cuts; shows total depth and degree of decarburization as well as effects of the atmosphere on constituents other than carbon on steel (2).

the bath, scrap tools or steel should be put through to determine whether decarburization has taken place.

The most commonly used method in evaluating the results of a thermal treatment is the file test, however, this method is rather crude and the information obtained is very limited. The hardness test also is used frequently for evaluation and comparison between several types of tool steel treated can be accurately compared in most instances. However, it does not evaluate the depth of either a decarburized or carburized skin. Thus, where a partial decarburization has resulted on a 2.5 percent carbon, high carbon-high chromium blanking die so that the surface carbon is reduced to 1.5 percent, the wearing qualities may be affected even though the hardness test indicates that the die is satisfactory.

Evaluation by Microscope

The microscope is essentially a laboratory tool. An advantage of this method of evaluation is that a photographic record of the sample can be realized. In addition it gives a true picture of decarburized or carburized skin, although it may not be sensitive to minute changes in surface chemistry. It does not always give sufficient data for the plotting of curves for comparison purposes, and special equipment along with technically skilled help is required to prepare the specimens and interpret results. Correlation between hardness and microscopic tests were made on several tool steel compositions. The material tested was machined to remove all traces of 'skin effect' and heat treated in an electric furnace utilizing a charcoal generated gas as the protective atmosphere. Tables and photomicrographs record the results obtained.

In Tables III and IV is shown data resulting from heating a high carbon tool steel (type A), a high carbon-high chromium tool steel (type B), and a high-speed steel (type C). Samples marked '1' were heat treated in a gas preparation unit obtained

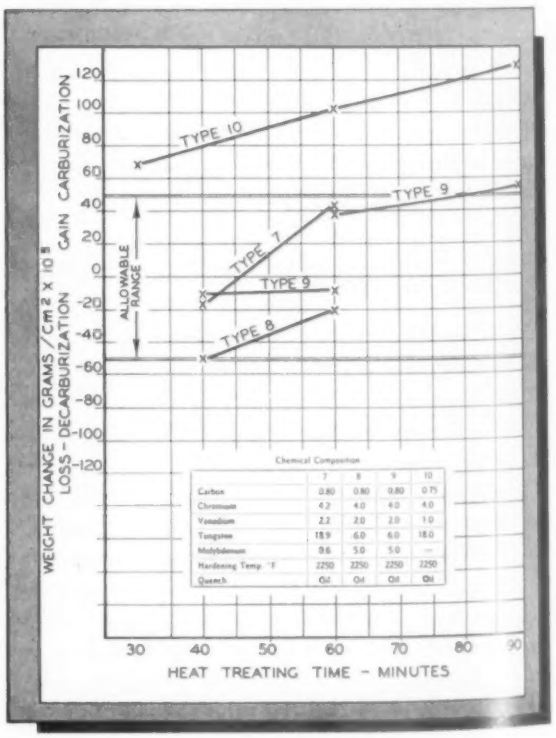
Table II Rockwell Hardness Results

Type of Steel	Hardening Temperature deg	Time at Heat min.	Quench Medium	Rockwell Hardness Quenched	Drawing Temperature deg	Time at Draw min.	Rockwell Hardness Tempered
A	1750	15	Atmos.	C63/C64	450	120	C56/C59
A	1750	15	Air	C63/C64	...	...	...
A	1750	15	Oil	C62/C64	450	120	C57/C58
B	1850	15	Atmos.	C62/C64	...	...	...
B	1850	15	Air	C61/C63	750	120	C56/C59
B	1850	15	Oil	C62/C64	750	120	C57/C58
C	1475	75	Oil	C61/C63	...	...	...
C	1475	75	Oil	C62/C64	350	60	C60/C62
C	1475	75	Oil	C62/C64	...	...	...
D*	2220	5	Oil	C62/C64	...	...	...
D*	2220	5	Oil	C62/C63	1050	120	C63
D*	2250	5	Oil	C60/C62	1050	120	C63
E*	2230	5	Oil	C62/C64	...	...	...
E*	2230	5	Oil	C63/C65	1050	120	C61/C63
E*	2230	5	Oil	C62/C64	1050	120	C62/C64

*A preheat at 1500 deg F for 15 min. period used prior to hardening heat.

by burning propane at a ratio of 14.5 air to 1 gas which gave approximately 5.0 percent carbon dioxide, 18.0 percent hydrogen, 10 percent carbon monoxide, 1.0 percent methane, 2.0 percent water and the balance nitrogen. The samples marked '2' were run through this gas preparation unit and in addition went through a cracking unit, the resultant atmosphere having a composition approximately 20 percent carbon monoxide, 20 percent hydrogen, 1.0 percent methane and the balance being nitrogen. A greater degree of accuracy in the Vickers Brinell hardness readings were obtained due to the use of a

Fig. 7. Results in hardening high speed steel in an atmosphere utilizing a carbon muffle are here shown in graph form for clear comparison. All samples are within allowable range even after long exposure at temperatures.



varying load. In examining the results that are tabulated, it may be noted that those samples that were treated in the gas preparation unit had decarburization, the high carbon tool steel (type A) being particularly bad. Those samples that were treated in an atmosphere that resulted from the cracking unit had satisfactory surface readings and higher hardnesses. Slight evidences of carburization were evident, however, due to the lack of microscopic examination, a quantitative analysis could not be obtained. In fact, there is little doubt that the carburizing effect, as illustrated by the increase of hardness at 5 Kg load, is but of minor importance.

Chemical Analysis Sometimes Advantageous

Another frequently used method in determining the surface effect of tool steel when heat treated under atmosphere is by chemical analysis of consecutive cuts. An advantage of this method is that accurate information can be obtained not only on carbon graduations, but on any other element within the steel that may be desired as well. The procedure that is usually followed is to use a test specimen 6 in. long turned down to a diameter of approximately 1 in. in order to remove 'bark' and to provide original centers for consecutive turnings. After suitable treatment within the atmosphere to be tested, consecutive cuts are made, the depth of which will vary from 0.002 to 0.005 in. A chemical analysis is made on each successive turning.

Softness from Annealing

Where samples are quenched from the atmosphere and exhibit high hardness, an annealing procedure must be included to obtain the degree of softness required for machining. This operation is

Table III Rockwell Survey on Hardened Tool Steel

Steel	Atmosphere	Quench	Vickers Brinell Hardness—Varied Load				
			5Kg	10Kg	30Kg	50Kg	125Kg
A1	Gas Prep.	Brine	176	200	287	348	470
A2	Gas Prep. and Cracked	Brine	909	920	898	906	912
A1	Gas Prep.	Brine and draw at 350 deg F	191	206	296	345	450
A2	Gas Prep. and Cracked	Brine and draw at 360 deg F	826	824	841	831	830
B1	Gas Prep.	Oil	811	772	786	789	770
B1	Gas Prep.	Oil and draw at 400 deg F	700	707	707	704	719
B2	Gas Prep. and Cracked	Oil	857	847	862	846	852
B2	Gas Prep. and Cracked	Oil and draw at 360 deg. F	781	762	763	762	762
C1	Gas Prep.	Oil	700	707	742	744	750
C1	Gas Prep.	Oil and draw at 1050 deg F	725	772	757	728	748
C2	Gas Prep. and Cracked	Oil	781	782	774	775	783
C2	Gas Prep. and Cracked	Oil and draw at 1050 deg F	857	824	792	798	773

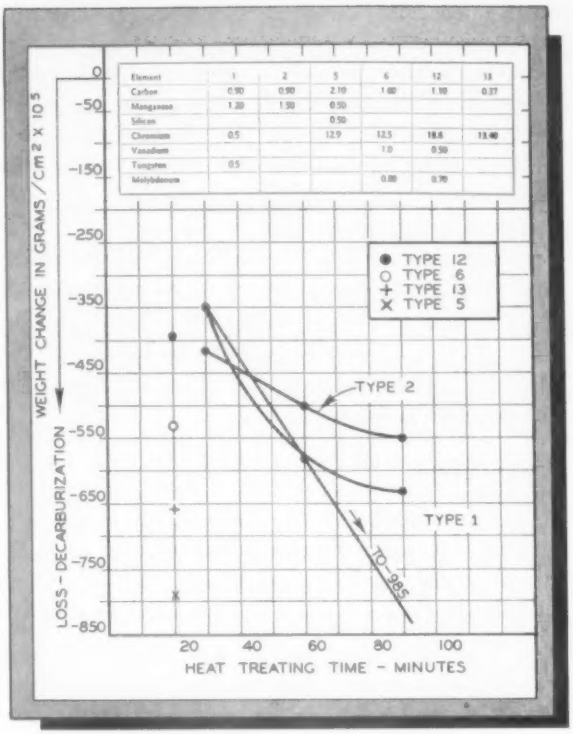


Fig. 8 presents results of tests made in semi-muffle furnace, with no atmosphere for protection. Note the substantial loss of weight due to decarburization.

rather critical since no surface reaction should occur to cloud the effect of the atmospheric thermal treatment. Thus, the specimens can be annealed in a small tube furnace equipped with a purified hydrogen atmosphere, or a lead bath which is suitably protected against surface oxidation.

The accuracy that is obtained by this method is directly related to the care taken in annealing to prevent surface reaction, the thoroughness in cleaning the chips obtained during machining, and the accuracy in making the chemical analysis. A typical graph as obtained by Koebel (2) is illustrated in Fig. 6 where both carbon and molybdenum survey was obtained.

Atmosphere Limit Change in Weight Test

The 'change in weight' procedure has been utilized by the author in evaluation of atmosphere. This method has proved to be quite accurate although it is limited to atmospheres that can be classified as 'scale free'. The slight discoloration that is acquired upon oil quenching usually does not affect the end results; however, any noticeable amount of scale will invalidate this procedure entirely.

This method has the advantage that a quantitative record can be made, as is the case with the 'consecutive cut' chemical method, however it is limited

to the determination of surface change. The procedure is quite accurate since a chemical balance scale is employed, however, care must be exercised in obtaining the weights. A pre-requisite is that all samples tested should be free from both a carburized or a decarburized skin prior to actual heat treatment within the furnace atmosphere.

Testing procedures on 11 types tool steel compositions were conducted in a Sentry furnace utilizing the carbonaceous muffle. Results obtained with the 'change of weight' method are illustrated in Figs. 7 to 9. The chemical compositions of the materials under test and the procedure employed are outlined in Table V.

Procedure

1. The samples were prepared in accordance to a symmetrical pattern so that the weight of each sample was under 150 grams, the top sensitivity of the balance. Each specimen was measured accurately.

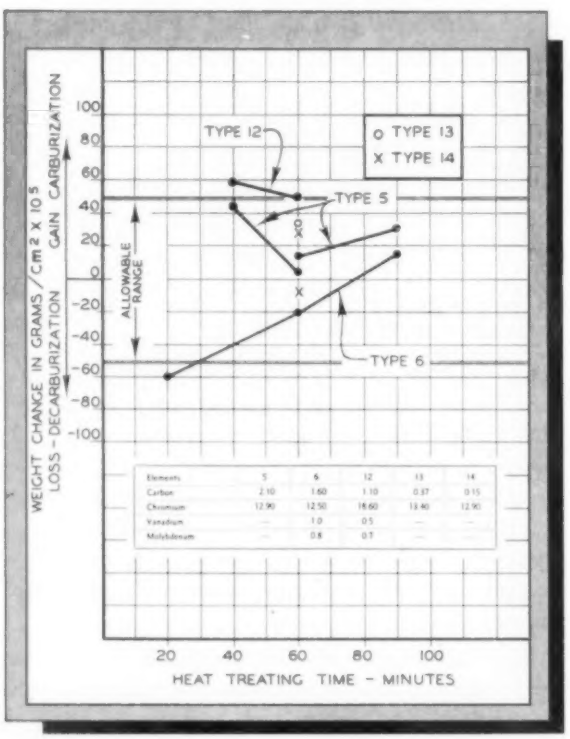
2. The specimens were ground to remove any traces of undesirable surface effect such as decarburization and the weight obtained to the fourth decimal place.

3. The samples were heat treated, in accordance with the conditions as recorded on the graphs, and quenched. It was assumed that the oxidation which may have taken place from the time it left the furnace until it entered the quenching medium was negligible.

4. The samples are then re-weighed to the fourth decimal place utilizing the same balance and a difference between the two weights was obtained. A loss of weight indicated decarburization while a gain in weight indicated carburization.

5. In order that the results obtained are placed on a common basis for comparison purposes, the loss or gain in weight obtained on each sample was divided by the total surface area of the specific sample; the area being measured in square centimeters. This figure may be quite small and in order to obtain a whole number, the result obtained is multiplied by a whole number such as 100,000.

Fig. 9 pictures graphically the results in hardening tool steel in an atmosphere utilizing a carbon muffle, and oil quench from 1850 deg. F. Note that in this case, too, compositions remain within allowable range.



Sample Calculations

1. Time of immersion of sample 5-2 (Fig. 9) within the furnace was 60 minutes.

2. The section size was 3.8 long, 2.0 wide and 1.85 in depth; all figures being in centimeters.

3. The area of the section in sq cm is: $(3.8 \times 2.0) + (3.8 \times 2.0) + (1.85 \times 2.0) + (1.85 \times 2.0) + (3.85 \times 1.85) + (3.85 \times 1.85)$ which is equal to 36.66 sq cm.

Initial weight	119.7390 grams
Final weight	119.7451 grams
Difference	±0.0061 grams
Factor	$(0.0061/36.66 \times 100{,}000 = +16.6$

Results

The effect of heat treating types 1 and 2 for periods ranging from 30 to 60 minutes; and of types 5, 6, 12, and 13 for a period of 20 minutes, are shown in Fig. 8. It will be noted that a substantial loss in weight is indicated due to decarburization. This is to be expected when heat treating in a furnace which has no atmosphere for protection. The results are more acceptable when the tool steel compositions had been heat treated under an atmosphere produced by the Sentry carbonaceous block. In graphing the results, as illustrated in Figs. 7 and 9, the allowable range of plus or minus 50 was accepted in accordance to Koebel's recommendation (2), since all of the sections that were tested had thicknesses ranging from ½ to ¾ in. It was interesting to note the tendency toward carburization of type 10 (Fig. 7), a standard 18-4-1 high-speed composition. This fact confirmed the results as obtained by Schlegel (6) who found a

Table IV Nominal Chemical Composition of Steels Tested

Steel	Alloying Elements						Percent
	Carbon	Manganese	Silicon	Chromium	Nickel	Vanadium	Tungsten
A	1.0	0.25	0.25	...	...	0.20	...
B	2.2	0.50	0.50	13.20	0.50 Max	...	...
C	0.75	0.25	0.25	4.10	...	1.10	18.0

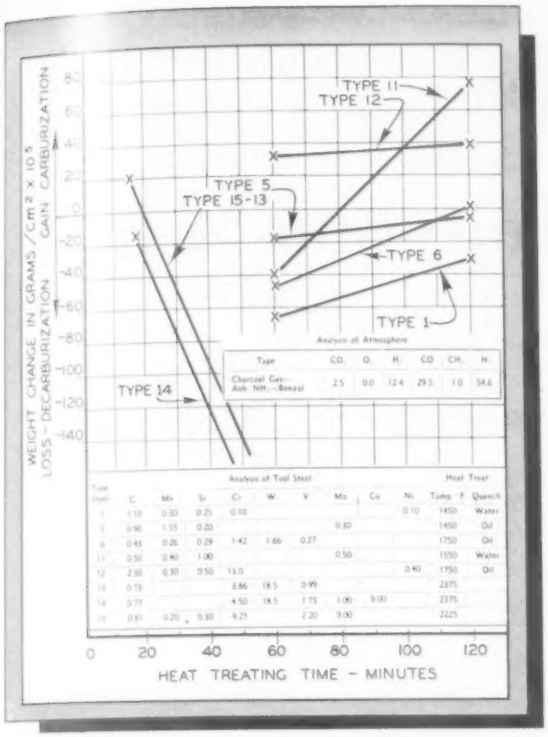


Fig. 10. Graph illustrates results of hardening tool steels in a charcoal generator gas containing anhydrous ammonia and benzol.—Koebel (3).

definite carburization occurring on this standard analysis when exposed to atmospheres rich in either carbon monoxide or oxygen. Limits in his investigation were up to 15.8 percent carbon monoxide and 9.0 percent oxygen.

Carburization Varies With Exposure Time

Both Schlegel (6) and Morrison (7) found that the degree of this carburization was in proportion to the time of exposure. They also discovered that, of the two influencing gages, the oxidizing atmosphere was more conductive to carburization. The degree of carburization on the 18-4-1 composition also is affected by the original carbon content within the composition. Thus, in that composition containing from 0.60 to 0.70 carbon, the carburizing effect is more noticeable than on a composition that contained a base carbon of 0.90 percent. Both investigators (6, 7) used a hardening temperature of 2350 deg F for relatively short periods of time exposure in the furnace atmosphere. The seriousness of the degree of carburization as determined by type 10 composition (Fig. 7) is not considered critical. This is because the exposure of tests performed are in excess of the normal time usually used in heat treating these compositions. However, from an academic view, the carburizing effect of this type of atmosphere on the 18-4-1 composition is of interest.

Alloys 7, 8 and 9, as illustrated in Fig. 7, are

Table V—Chemical Composition

Steel Type	Carbon	Manganese	Chromium	Vanadium	Tungsten	Molybdenum
	Alloying Elements				Percentages	
1	0.95	1.20	0.50	...	0.50	...
2	0.95	1.60	...	...	...	...
5	2.10	0.50	12.90	...	...	...
6	1.60	0.30	12.50	1.00	...	0.80
7	0.80	...	4.20	2.20	18.90	0.60
8	0.80	...	4.00	2.00	6.00	5.00
9	0.80	...	4.00	2.00	6.00	5.00
10	0.75	...	4.00	1.00	18.00	...
12	1.10	...	18.60	0.50	...	0.70
13	0.37	...	13.40	...	...	...
14	0.15	...	12.90	...	...	...

all within the allowable range even after long exposures at temperature. This is also true of those compositions as illustrated in Fig. 9. Of interest is the change in weight obtained by Koebel (3) on eight tool steel compositions (Fig. 10) that had been thermal treated in an atmosphere obtained from a charcoal generator gas to which anhydrous ammonia and benzol had been added. The resultant composition of the atmosphere, which was highly reducing, contained 2.5 percent carbon dioxide, 12.4 percent hydrogen, 29.5 percent carbon monoxide, 1.0 percent methane and the balance nitrogen.

Surface Reaction May Be Disadvantage

The 'change in weight' method has some disadvantages which must be recognized by potential users in evaluating protective atmospheres. The surface obtained must be scale free or bright after thermal treatment in order to obtain valid results. In addition the results will only indicate whether or not an undesirable surface reaction has taken place—no information as to the depth of the surface reaction can be obtained. For this information, it may be necessary to employ the microscopic method of examination.

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Inspection by Optical Projection Methods

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Part II

INSPECTION BY OPTICAL projection was greatly accelerated by the tremendous gaging demands of World War II. Because of the importance of spare parts and interchangeability requirements, most ordnance material must be carefully and thoroughly inspected. In the early stages of our armament manufacture, mechanical gages of all types were supplied to contractors and to responsible Ordnance Districts. Gages were designed on the basis of the original parts specifications and, in order to satisfy the tremendous inspection requirements, many duplicate gages were manufactured. These gages covered all types from plain plugs to very complicated and costly fixture-type gages. Gage-making capacity in the United States is considered to be adequate during normal times, but the demand during the period of tooling for war is tremendous. Special skills are required in gage making, and special equipment is used for manufacturing and checking. This industry was not only over-burdened with manufacture of new gages, but wear on gages was very rapid and this meant constant reworking. The same type of equipment and personnel is required for repairs; in fact, in many instances salvage of gages is even more exacting. There was a far greater difficulty, however, in that many of the ordnance items were new items, never before manufactured on the production line, and with manufacturing experience it was expected that many component changes were to be made. The unfortunate consequence was that changes in gage design and subsequent remaking were necessary. The gargantuan tasks imposed on gage-making capacity in this country made that industry one of the most critical. Gage manufacturing and gage repair was slow, and unfortunately gages were a most important consideration before parts could be accepted.

Fortunately, in the early stages of the war, developments were being made for the practical and economical method of making and duplicating chart gages. Good optical comparators were available commercially and, since charts were no longer a problem, development of optical projection technique moved ahead rapidly.

Presented at Annual Meeting, American Society of Tool Engineers, March 16, 1951

Multiple Advantages For Optical Comparison

The following are some of the many advantages of this type of inspection, from the Ordnance point of view:

(1) In many instances, only one comparatively simple work-holding fixture is required for complete inspection. It is not uncommon to have as many as 10 to 20 various mechanical gages on even the simplest part. Thus, optical inspection eliminates the need for several inspectors to keep up the inspection rate. It also virtually eliminates the parts handling and rehandling, the use of many sets of gages, and the constant surveillance of gage condition, which were required under manual gaging inspection. With work-holding fixtures, to be used on contour projectors, wear is usually not a factor. In those cases where it is a consideration,

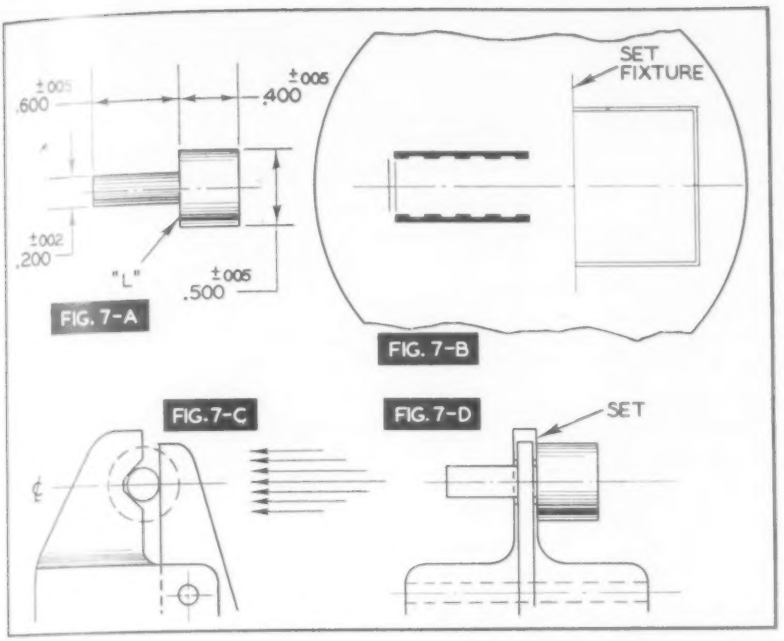


Fig. 7A. Shown here is a typical small part which is to be gaged by optical comparison, and for which a chart layout is studied. Fig. 7B shows the resultant chart with the "bridge" line for clear visibility. At Fig. 7C, side view of the work-piece located in a Vee is pictured, while at 7D is shown the front view of the work-holding-fixture with the part located in position and "shouldered" against the reference surface indicated as a "set" surface.

properly engineered fixture design makes it possible to quickly replace the worn elements.

(2) Usually the part may be located in exactly the same manner as in the assembly, providing a most desirable condition.

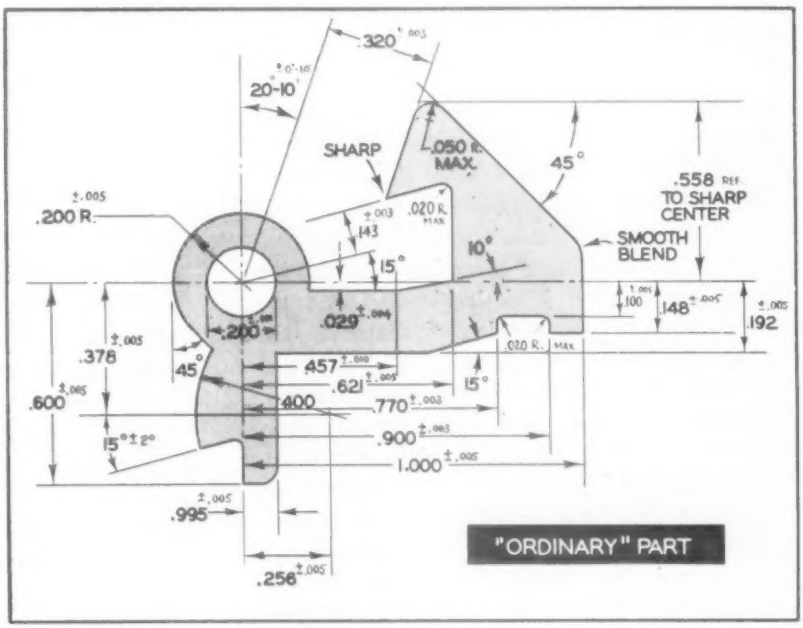
(3) Component changes can often be made without affecting work-holding fixtures; even in extreme cases, if a change is required, it is usually one of a minor nature.

(4) It is not difficult to train inexperienced inspectors to do a thorough job, since 'feel" and personal judgment have been completely eliminated. A supervisor can look over the shoulder of an inspector and watch parts being inspected. Both inspector and supervisor are able to see exactly the same conditions, and there is no need to depend on personal judgment as to the proper "feel".

(5) When inspection rate demands it, exact duplicate set-ups can be made. Proper design of holding fixtures assures duplication in manufacture and calibration of these fixtures. The glass chart is an exact duplicate because of the method of manufacture. Production of a component part can be carried on in widely separated plants and yet, using this type of inspection equipment, can be depended upon to be exactly alike.

(6) When component changes are made, it is usually a simple matter to change the original

Fig. 8 illustrates the complexity of what may appear at first to be a simple gaging problem. Note the many dimensions which would prove considerable problem if gaging by mechanical means.



master scribing and to supply new charts. Therefore, gage-making capacity need not be used, and the new inspection equipment is almost immediately available.

Planning for a Typical Part

Consider a part such as that shown in Fig. 7A. It is planned to use a contour projector which has dependable and accurate optical performance over the entire 14 in. screen area.

Because of its effect on fixture design, the chart layout is considered first of all. The magnification selected is of importance. 10X magnification is investigated and immediately it is found that the total length of the part is about 1 in. long and at the magnification, it would be 10 in. long. This size of "shadow" will fit on the 14 in. screen. However, before final decision can be made as to the advisability of using 10X, we must study the magnitude of the tolerance on each dimension to be checked. The smallest tolerance to be checked is on the 0.200 in. dimension which has the ± 0.002 in. limit. The part can be held in a Vee and thereby the imaginary centerline of the part can be established. However, this results in reducing the tolerance to the limit on each side of the centerline. It is impractical to use the double-line system for checking this resultant 0.002 in. tolerance, since at 10X the lines would be 0.020 in. apart and therefore difficult for the operator to see clearly. The "bridge" line, however, would indeed be practical. Therefore, since we are able to satisfy the smallest tolerance, 10X is satisfactory. Fig. 7B shows the resultant chart with the "bridge" line for the 0.200 in. diameter, the conventional double lines representing the tolerance of the other dimension.

Size and Dimensions Determining Factors

Because of the manner in which the part is dimensioned, it seems most practical to locate it in a fixture against surface *L*, since the two length dimensions 0.600 in. and 0.400 in. are with reference to this surface. Also, since this part has two diameters held in relation to each other about a common centerline, it is desirable to locate the part in a Vee and, for convenience in handling, the 0.200 in. diameter is the locating diameter and thereby the side of the work-supporting Vee can be the reference locating surface for the two length dimensions. At 7C is shown a side view of the work-piece located in a Vee; the Vee opening is in the vertical plane. This is essential since, regardless of variations in diameters, the centerline of the part would also change in position. At 7D, there is shown the front view of the work-holding fixture with the part located in position and "shouldered" against the reference surface indicated as a "set" surface.

It is essential to coordinate the fixture position to the chart position when making the initial set-up. To do this, the operator places the chart in position and then slides the fixture on the work table until the shadow of fixture "set" surface is coincident to the vertical "set" line of the chart gage. The vertical "set" is accomplished by elevating the comparator work stage until the 0.200 in. diameter of the part is centered in the chart "bridge" line. In one fast operation, the operator slides the part into position and views the magnified shadow against the chart screen to check all dimensions at one setting.

The part illustrated in Fig. 7 is typical of many small parts which appear to be simple from the standpoint of gaging. However, as shown by Fig. 8, there are many dimensions which would prove to be a problem when gaging by mechanical means. With the properly designed chart and fixture, this inspection problem resolves itself into a comparatively simple inspection procedure.

Size Limitations Few For Projection Method

With inspection by the optical projection method, there is virtually no limit to size of part, since the work-holding fixture can be designed so that the part mounted therein can be shifted a known distance, to bring into view the portions of the part to be checked. The amount of shift or movement of the part is determined not only by the size of the part but often by the required magnification for checking close tolerances. Because of the nature of the part and the close tolerances involved, it is often necessary to check at 50X magnification and, if the part was 1 in. long, the 50X magnified shadow of the part would be 50 in. long. A comparator having a screen area sufficient to see the part in its entirety at this magnification is not available because of the many complications in lens manufacture. Further, it would be impractical from the operator point of view, since it would be impossible to see the extremities of the part while sitting in one position.

The system of mechanically shifting the component part to definite locations is virtually limitless. Carefully engineered chart lines can be coordinated with these fixture shifts so that there is no confusion for the operator and, although the chart by itself may appear to be meaningless when the part shadow is cast upon it, there is no mistaking the appropriate lines for the related portion of the part.

Steel-Spring-Type Vibration Mountings For Machine Tools

By Donald H. Vance

ASSISTANT GENERAL MANAGER AND EXECUTIVE ENGINEER
THE KORFUND COMPANY, INC.

Part III

Characteristics of Steel Spring Mountings

High Isolation Efficiency: Commercial stock spring isolators provide deflections up to approximately 1¼ in., exceeding the usual ¼ in. maximum of other materials. Table II shows isolation efficiencies of mountings providing 1¼ in. and ¼ in. deflections for a range of disturbing frequencies often encountered on actual installations.

Low-frequency Shock Absorption: In this range, mountings simply transform the sudden impact to a more gradually applied force. The smaller the transmitted force and the greater the time through which it is applied, the less effect it will have. Since a much higher safety factor is required for impact conditions than for steady vibration, a mounting which might otherwise provide a maximum deflection of ¼ in. would probably not be loaded to more than ⅛ in. deflection under the static weight of the machine, in order to allow a safe margin for the impact. On the other hand, standard steel spring units could easily be loaded to at least ½ in. deflection under the static weight with ample safety factor for the impact load. Since both mountings must carry the same static load, the static deflection of the spring mounting will be four times as great as the static deflection of the other mounting at the initial load. Since both mountings must absorb the same impact energy, the area must be equal.

This is shown in Fig. 7 where it can be clearly seen that the maximum force transmitted by the spring mounting, P_s, is much less than the maximum force transmitted by the other mounting, P_o, for the same amount of energy absorption. K_s and K_o are the load deflection constants of the steel spring and other material respectively.

Positive Vibration Isolation

Presses: Most presses can be mounted directly on spring isolators. Where presses are equipped with overhanging flywheels, stiffer springs are provided on the flywheel side to accommodate the greater weight. The isolators on the flywheel side of an inclinable press are provided with sufficient capacity to accommodate the press in any position from vertical to fully inclined. If a press is extremely top heavy, it is sometimes necessary to provide a steel base to spread out the isolators. On very large presses it is sometimes necessary to use a spring-isolated concrete foundation. Hydraulic presses up to 1,000 tons capacity have been thus isolated with success.

Forging Hammers: The installation consists of a properly designed concrete foundation floating on springs, equipped with a means for keeping the foundation level at all times, and incorporating adjustable snubbers to limit the movement of the foundation when the blow is struck. Fig. 8 illustrates the usual construction. The entire hammer whether drop or flat-die type, rests on the floating concrete foundation block. Instead of the usual multiple layers of timber under the anvil, only one layer is used, to prevent spalling of the concrete. Structural steel beams running through the reinforced foundation block transmit the weight to the steel spring isolators which support the hammer and foundation and prevent the hammer vibration from being transmitted into the building or ground.

Positive or Negative Isolation, or Bath, for Machine Tools: Such machines as millers, shapers, and broaches are frequently the source of disturbing vibration. Even lathes and ball grinders taking heavy rough cuts will transmit severe vibration. The frequency of the disturbing vibration in millers is equal to the rpm of the spindle multiplied by the number of teeth on the cutters. The vibration generated by shapers, broaches and lathes taking heavy cuts is of low frequency (equal to the strokes per minute, teeth per minute, or rpm) and is treated as impact or shock rather than steady-state vibration. Most machine tools of this type can be mounted directly on the isolators.

Presented at Annual Meeting, American Society of Tool Engineers, March 13, 1951

Table II—Typical isolation efficiencies of two materials for different disturbing frequencies, showing the effect of deflection and natural frequency.

Natural frequency f_n, cpm	238	300	400	500	545	600	700	800	900	1000
1¼ in. defl., $f_n = 168$	0%	55%	80%	87%	90%	92%	93%	95%	96%	97%
¼ in. defl., $f_n = 386$	magnify 1.6	magnify 2.98	magnify 13.2	magnify 1.49	0%	38%	60%	72%	79%	85%

However, millers, broaches, lathes, gear cutters and similar machine tools may also be affected by severe external vibration from such equipment as punch presses, hammers, and passing trains. Effective vibration control mountings will provide two-way isolation; they will prevent vibration transmission from the machine tools when they are generating such vibration on rough cuts, and will also protect machine tools from external vibration when they are taking finishing cuts. One interesting installation is on a very large machine used for cutting Naval gun turret gears up to 60 ft in diameter. The machine is mounted on a spring-isolated foundation, the total supported weight being over one million pounds.

Lathes are particularly good examples where one machine taking a heavy rough cut may generate severe vibration which shows up as "chatter" marks on the work of another lathe in the same room which is being used for the final finishing operations.

Negative Vibration Isolation

Many machine tools such as most grinders and jig borers, and auxiliary equipment such as optical comparators, layout and flame cutting tables, and surface plates never create vibration themselves but are adversely affected by external vibration. Effective vibration control pays big dividends when used under such machines.

Cutter, centerless, surface, cylinder and similar types of grinders can be mounted directly on the vibration control units. The mountings are usually located at the same points where the manufacturer provides leveling screws or foundation bolts.

Roll Grinder: A concrete foundation is always recommended between the grinder and the isolators, as in the case of the 3,000,000 lb. roll grinder shown in Fig. 9. This is primarily because a roll grinder is so long, and the weight of the rolls is so great, that it is impossible or impractical to build a grinder rigid enough to eliminate all deformation and misalignment in the machine. Unlike smaller machine tools, leveling the roll grinder, or other very long machine tools such as large lathes, actually may involve "bending" the machine to compensate for deformation due to its own weight. Consequently, concrete foundations are required for all such installations.

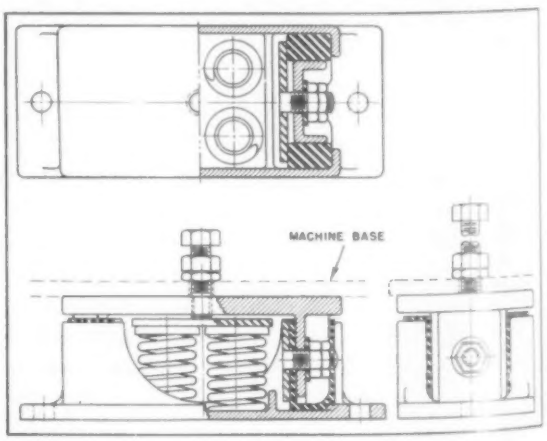
After the concrete foundations have been poured and have set, and before leveling the roll grinder, the foundation is raised on the spring isolators and is leveled by means of adjusting bolts. The foundation should be leveled first, for it is possible for a foundation of this size to deflect due to its own weight. The roll grinder is then leveled or trued with respect to the horizon of the earth, not the surface of the concrete foundation on which it rests. This is true even on a conventional non-isolated installation. This means that once the roll grinder is accurately aligned by leveling, its alignment will not be affected by the slight tipping of the entire installation produced by the heavy grinding head moving back and forth on the machine. Actually, the weight of the concrete mass is so much greater than that of the moving weight that the angle of inclination is limited to only a few minutes, but the tipping could be even greater without affecting the performance of the grinder. Only the distortion of one part of the grinder with respect to another part can cause inaccuracy, and this is prevented by the concrete foundation.

Optical comparators, flame cutters and similar relatively light-weight machines should be mounted on a concrete inertia mass supported on spring isolators. Light-weight, high-precision equipment cannot be satisfactorily protected by mounting them directly on the isolation material.

Distinction Between Machine Tool Level and Alignment

A review of the records of a half-century's experience in isolating machine tools, and actual observation of hundreds of installations, prompts

Fig. 7. Pictured here is Korfund Type LK Vibro Insulator with adjustable snubbers.



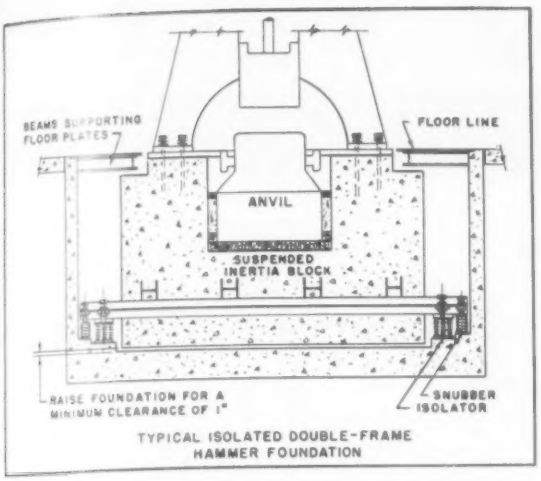
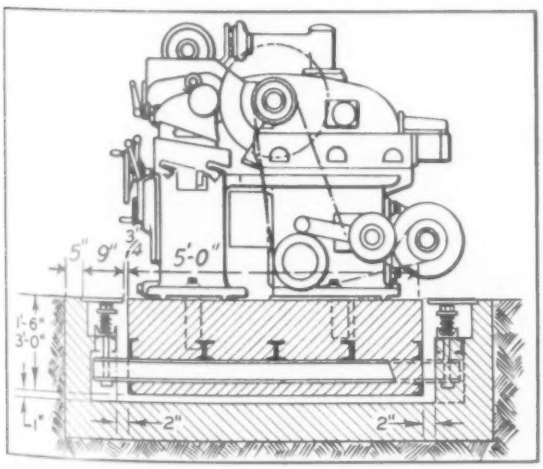


Fig. 8 illustrates usual construction for forging hammer vibration control.

the writer to make the statement that the vast majority of machine tools do not need to be level, and that being out of level at least several degrees will in no way affect the accuracy of the tools. Some engineers have undoubtedly reached this conclusion based upon specific experience; others will not agree immediately, possibly because they consider the level and the alignment of a machine to be synonomous, whereas there is a very important difference. This question is important because it comes up frequently on vibration control installations and is an objection sometimes raised by machine tool manufacturers and machinists to the use of vibration mountings.

A machine tool must be properly *aligned* to do accurate work. There is no doubt about this fact. However, "alignment" refers to the position of the different machine parts relative to one another, not to the position of the machine as a whole. "Level" refers to the position of the machine as a whole with respect to the earth's horizon. On most machine tools, precision alignment is built into the machine at the factory, can often be adjusted in the field, and is protected by the rugged construction of the machine tool frame which does not permit deformations of the frame and other parts of the machine tool, the only condition which can cause misalignment. With few exceptions, grinders (except roll grinders), milling machines, shapers, jig borers, boring machines, and similar self-contained machines can be out of level and do just as satisfactory work.

Fig. 9. pictures a Naxos-Union Roll grinder; its 300,000-lb. weight supported on 20 isolators. (Aluminum Co. of America)



However, if a machine tool is installed on a non-level floor and is then bolted down rigidly, this can often result in misalignment and may be the reason why so many people think of the two as being synonomous. For example, a machine may be designed for four-point support, but rests on three points and the fourth leg is just a few thousandths of an inch above the floor. If this high corner is bolted down, the machine frame will often be strained and misaligned by the force exerted through the foundation bolt. Actually, most vibration mountings make such distortion of the frame impossible, because it is practically impossible to exert such forces on the machine frame through the mountings. Of course, the machine in this example should be properly supported at all four points; on mountings having built-in leveling screws, the initial unevenness of the floor is compensated for in this manner; otherwise shims should be used.

However, provided the machine is supported properly at the designed support points, any tilting of the machine on vibration mountings during operation due to reciprocation of the work table, cutting head, or for other reasons, will not cause misalignment of the machine. This has been demonstrated conclusively on thousands of machine tool installations. A practical example is machine tool installations aboard ships, where the machine tools must and do perform accurate work even though the ship is pitching and rolling constantly, through angles of many degrees.

On very long machines, such as roll grinders, and large lathes, where the machines length makes it impractical to build this kind of rigidity into the machine, such machine tools must be supported on isolated concrete foundations.

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JIC Pneumatic Standards for Industrial Equipment
(Conclusion)

A6.2—Sealing Devices

A6.2.1 All sealing devices must be of such materials that they will not be adversely affected by air or lubricants.

A6.2.3 Sealing devices on reciprocating or rotating shafts shall prevent leakage, except that required for lubrication of such devices under working conditions without damaging shafts.

A6.2.4 Clearances in sealing glands shall be such as to prevent undue extrusion of the sealing material.

A6.2.5 Stuffing boxes for automatic packing shall be so designed as to prevent adjustment beyond the functional limits of the packing.

A6.2.6 Industrial equipment shall be so designed as to facilitate easy replacement of packings.

A6.2.7 JIC Standard part numbers shall be provided for all packings. If none available, principal dimensions such as inside diameter, outside diameter, stack height and material shall be provided.

A6.3—Cylinders and Pistons

A6.3.1 Cylinder bores having fitted pistons shall be finished in a manner consistent with the type of service intended and shall be free of porosity or other defects.

A6.3.2 Cylinders shall be located in alignment with work slides, and shall be such that no side or radial load shall occur on piston rod or ram, unless other suitable provisions are made to take such loads.

A6.3.3 Ends of cylinders shall utilize sealing devices that do not leak under manufacturers' intended operating conditions. Cylinder external sealing devices shall be readily accessible for servicing.

A6.3.4 (a) Cylinders shall be accessible for servicing.
*(b) Cylinders shall be separate, not cast integral with equipment.

A6.3.6 Piston rods shall be adequately protected by installation of cleaning and sealing devices. Material and hardness of piston rod shall be such as to prevent scoring.

A6.3.7 When pistons are assembled to rod they shall be positively locked.

A6.3.8 When necessary, cushions shall be provided on cylinder ends.

A6.4—Valves

A6.4.1 Adjustable valves shall be arranged so that wires and seals can be used after final adjustments and locking.

A6.4.3 When practicable subplate mounted valves (or equivalent) shall be used so that their repair or replacement can be made without disconnecting individual air lines. Seals of the pressure sealing type or seals of a type that will provide the equivalent of pressure medium sealing type are recommended. Means shall be provided so that subplate mounted valves cannot be improperly assembled to the subplate.

A6.4.5 The operation of a valve shall not contribute to detrimental surges in the pneumatic system.

A6.4.6 On vertical or inclined slides or rams means shall be provided to prevent rapid drop when air power is shut off.

A6.4.7 Solenoid operated valves shall be so designed, constructed and installed as to eliminate destructive hammering.

A6.5—Storage or Surge Tanks

A6.5.1 Tanks shall be so constructed as to conform to State Regulations. Where no regulations are in effect, they shall be so constructed as to withstand at least five (5) times the operating pressure of the pneumatic system they serve.

A6.5.2 Tanks shall be so designed and constructed that they cannot be disassembled while containing an unsafe charge. Means shall be provided for safety relieving air pressure.

A6.5.3 Pneumatic circuits incorporating tanks shall be so arranged that the system can be bled at the low point of the circuit.

A6.5.4 See Paragraph A7.1.3 of the "Safety" section.

A6.5.5 Where applicable, all tanks shall incorporate suitable automatic condensate dump valves and suitably protected water indicators.

A6.6—Storage or Surge Tank Nameplate

A6.6.1 The following information shall be permanently indicated on each tank:
(a) National Board Serial Number.
(b) Name of manufacturer.
(c) Maximum allowable working pressure.
(d) Manufacturer's serial number.
(e) Year built.

A7—Safety

A7.1.1 Flexible lines shall be restrained or confined, if their failure might constitute a hazard to personnel.

A7.1.2 Operator shall not be required to reach past revolving spindles, moving tools, or moving machine or equivalent elements to reach manual controls.

A7.1.3 Pneumatic circuits incorporating storage or surge tanks shall be so interlocked as to vent or isolate pressure when power is shut off. On circuit applications where tank pressure is isolated, full information shall be given on or near tank for proper servicing without injury to personnel.

***Engineering Developments:** Standard specifications noted with an asterisk (*) were written as a guide in indicating the type of engineering that is considered to be desirable in new developments and in the re-engineering of equipment.

Methods Check List for Welding Set-Up

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Classification One

1. Are the following parts of operator's body protected: (a) eyes, (b) arms, (c) torso, (d) legs?
2. Would in-service or other types of training increase the capacity of the operator?
3. Is the job being done in the prescribed manner?
4. Does the operator accept only properly fit work for processing at his station?

Classification Two

1. Are the following factors of environment conducive to the performance of work: (a) ventilation, (b) lighting, (c) temperature?
2. Does the workplace layout permit maximum use of the welder?
3. Do the tools of the workplace suit the work requirements?
4. Does the workplace provide for a continuous flow of incoming and outgoing material?
5. Does the workplace have adequate material handling devices?
6. Can fixtures supplement or reduce handling?
7. Would a simple positioning fixture help the operator perform his task?
8. Can jigs be used for holding during welding?
9. Are accurate jigs being used?
10. Do jigs provide easy access to the weld joint?
11. Are the jigs easy to load and unload?
12. Can an automatic work positioner and mover be used?
13. Does the welding equipment have an adequate capacity?
14. Are the various parts of the welding equipment functioning properly?
15. Is there adequate welding control for the job being done?

Classification Three

1. Has the welding procedure been planned?
2. Is the planning adequate in scope?
3. Does planning of the fabricating procedure originate in the engineering department?
4. Has production been planned to utilize the worker's familiarity with specific jobs?
5. Does the layout efficiently execute the preplanned operations?
6. Has the personnel been sold on the method of processing being used?
7. Does the volume of work lend itself to straight line production?
8. Can the welding and fitting on any one sub-assembly be established as straight line production?
9. Can the work be simplified by using more sub-assemblies?
10. Does the volume of work warrant the introduction of new machines and fixtures?
11. Does work volume justify expensive fixtures?
12. Does the flow of work between stations proceed smoothly?
13. Can operations be rearranged or eliminated through use of more accurate jigging?
14. Would the use of more accuracy in preparation of parts permit elimination of tack welding?
15. Can an improved cleaning procedure lead to less operations?
16. Does the required accuracy of work demand more inspection during processing?
17. Is the welding sequence an efficient one?
18. Is waste occurring because of poorly fit work?
19. Can the weld be done automatically? Will this add space for other operations?

Classification Four

1. Is the part designed for functional efficiency?
2. Would a redesign of the part provide better welding conditions?
3. Would a redesign of the part permit simpler jigging to be used?
4. Would a redesign ease assembly problems?
5. Does the design provide inherent part support?
6. Is the most efficient weld joint being used?
7. Are the weld joints readily accessible?
8. Does the weld joint design conform to welding process limitations?
9. Will this new design be producible with existing plant equipment?

Classification Five

1. Will a redesign eliminate any welding cost?
2. Could welding be eliminated by using a new material?
3. Would the use of a different material provide better welding conditions?
4. Would a combination design using several welding processes for joining improve the product or reduce its cost?
5. Should the part be redesigned for joining by another welding process?
6. Can a combination of materials be used?
7. Is the purchased material of the right size? Would a different size of purchased material reduce fabricating costs?

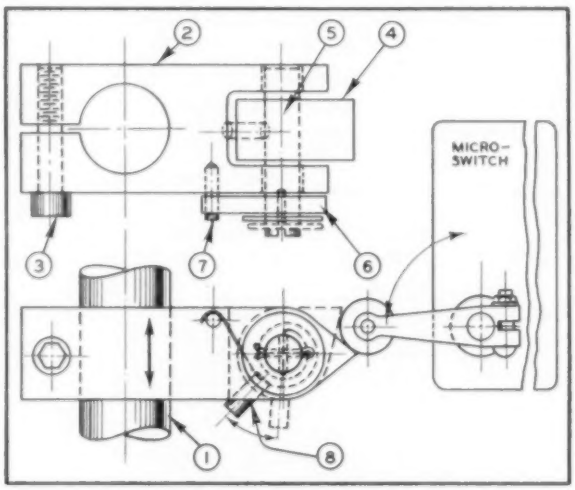
Gadgets

Ingenious Devices and Ideas to Help the Tool Engineer in His Daily Work

Switch for Paint Sprayer

In designing an automatic paint spraying machine, a compact adjustable trip was needed to trip the switches used to turn moving spray guns on and off at certain positions during their travel. The illustration shows the simple, inexpensive trip developed to meet these conditions. As several of them have now been in use for over two years, during which they have proven themselves entirely satisfactory, I pass the idea along for benefit of tool engineers having similar problems.

Rod 1, which is moved up and down by an air cylinder, carries a spray gun at its upper end. It also serves as a mounting for the microswitch trip, the latter being carried on the block 2 which, in turn, is clamped to the rod by set screw 3. The trip can thus be readily adjusted along the rod to any desired position.



A simple trip, for microswitches, opens and shuts spray guns during their travel on an automatic paint spraying machine.

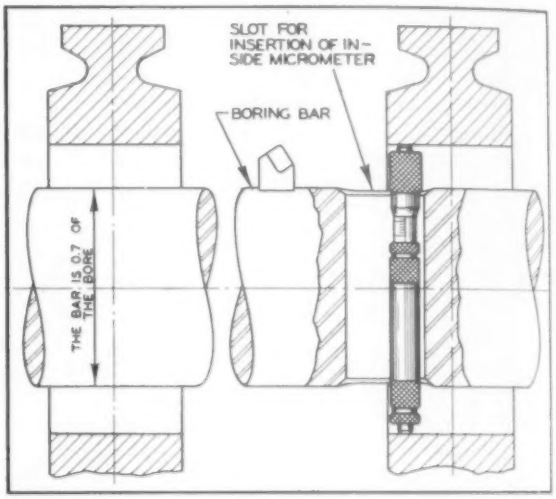
The trip roller, 4, is a press fit on shaft 5, which is free to turn in the block 2. The shaft, slotted on one end, is held under tension by spring 6, which is looped over pin 7. The spring normally holds the trip roller in position shown by means of the pin 8, which stops against the block 2.

In that position, the trip is ready to actuate a microswitch on the upstroke of rod 1. On the down stroke, the trip is deflected, as shown by the dotted lines, and thus by-passes the microswitch arm, when the spring returns it to original position.

Charles E. Hayward
Grand Rapids Chapter, ASTE

Measuring Bores

Measuring bores by means of inside micrometers, without removing the bar from the work, can usually be done by slotting the bar as illustrated. The slot—it can be a drilled hole if bar diameter permits—should be just ahead of the boring tool.



By slotting or drilling a boring bar just ahead of the boring tool, as shown, bore diameters may be gaged with inside mikes without removing the bar or disturbing cutting settings.

Generally, the bar diameter should be 70 percent of the bore diameter. When using over-the-bar inside tubular mikes however, the bar can be 50 percent maximum of bore diameter only and less than 100mm or 4 in. diameter. For precision boring of bearings in crankcases of internal combustion engines—or similar boring operations—a bar diameter of 70 percent in relation to the bore is preferred, especially for longer multi-cylinder cases.

The slot eliminates need of disassembling a line bar to take accurate measurements, and otherwise obviates unnecessary handling of the bar which might disturb cutter setting. This is especially advantageous when several in-line bearings are to be bored simultaneously.

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Member-at-Large
Bergen, Norway

The Tool Engineer pays regular page rates for accepted contributions to these pages, with a minimum of $5.00 for each item.

Short Cut to Optical Projection

Scale layout of light rays, through lenses and reflection by mirrors, serves the several fold purpose of eliminating calculation of angles, with incidental saving of time, and also of bringing the image close to the object to be projected. If the particular lens used gives a certain magnification in a certain distance between object and image, such as with a comparator or other optical instrument, one simply draws the components to scale—say $\frac{1}{8}$ or $\frac{1}{4}$ size.

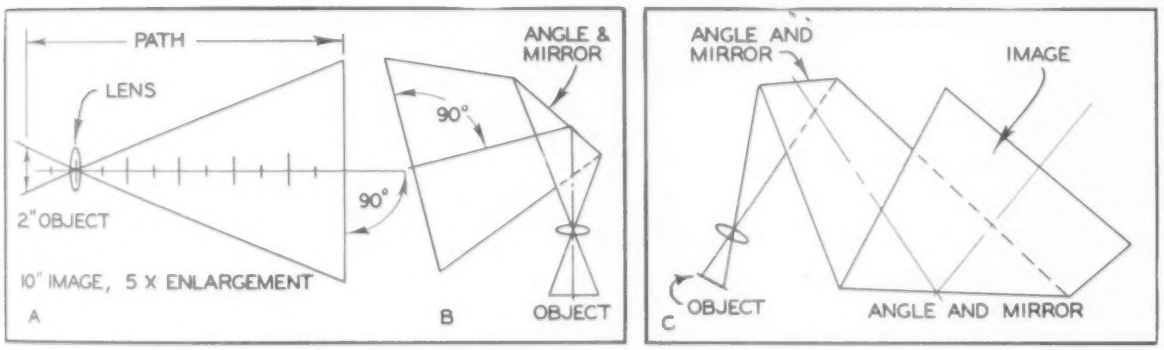
The drawing should be on thin tracing paper, so that one can see through it, and laid out as suggested by Sketch A. One then folds the paper to the proportion that the object and image should be positioned when the start and finish ends are in their desired directions and with the object and image always at right angles to the center line of the beam. The angles will be formed automatically, without use of a protractor or other measuring means, and construction simply follows the angles thus generated. Single and multiple folds are suggested by Sketches B and C.

As a typical application, assume that it is desired to project an image—say the shadow of a small part—onto a screen for measuring or viewing purposes. If it is further desired to see the image close to the object or part; one simply bends the light beam at some point that will bring it back to the desired point.

Now, assuming that 60 in. total distance between object and image—termed the "path" on Sketch A—would be required for a magnification of 10 X, the only problem is where to place the mirror or mirrors, as suggested by Sketches B and C. Since the object and image are drawn to scale and in proportion to magnification, and because the path is marked off into divisions, one needs merely fold the paper diagram to the desired proportion which then determines the location of object, lens, and image in full-scale layout. It is essential that the light beam be at right angles to the object and image, to prevent distortion. If properly scaled, the result will always be right and the "kink" will save time to boot.

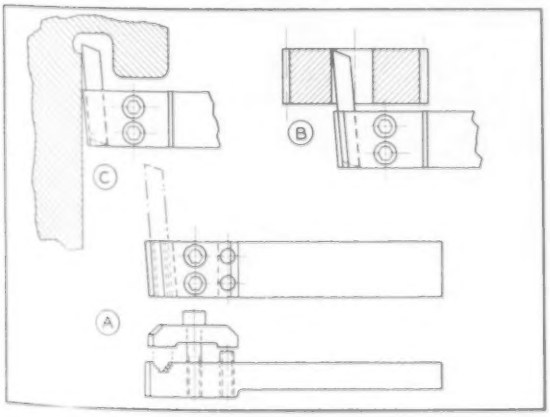
Herman Rueger
Lancaster, Pa.

By bending light rays to known proportions, as suggested by the several sketches, one may not only shorten the distance between object and image, in optical projection, but save the time ordinarily required for computation of angles.



Versatile Tool Holder

The tool holder indicated by A has been proven handy for awkward jobs on the shaper. The body is slotted to receive $\frac{1}{4}$, $\frac{3}{8}$ and $\frac{1}{2}$ in. standard tool bits, the slots being milled at an angle so as to provide clearance for the tool bits. The bits are ground with the cutting edges on the end, as for a slotting tool. The clamp is levelled, to suit the size of tool bits used, by two adjusting screws.

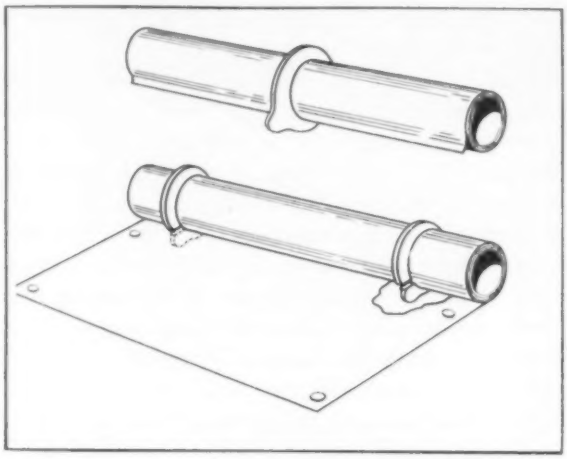


B shows the tool holder in operation as used for cutting an internal keyway in a small gear. Keyways such as this may be cut up to about $1\frac{1}{4}$ in. long, using standard tool bits. For longer keyways, a special bit must be used. C shows how the tool may be used to finish a face under a casting overhang, this being one of many applications for this handy tool holder.

Merle L. Deckard
Detroit Chapter

A tool holder such as shown at left is applicable to a wide range of work on the shaper.

Holder for Blueprints



Rubber jar rings keep rolled-up blueprints from rolling on a drawing board.

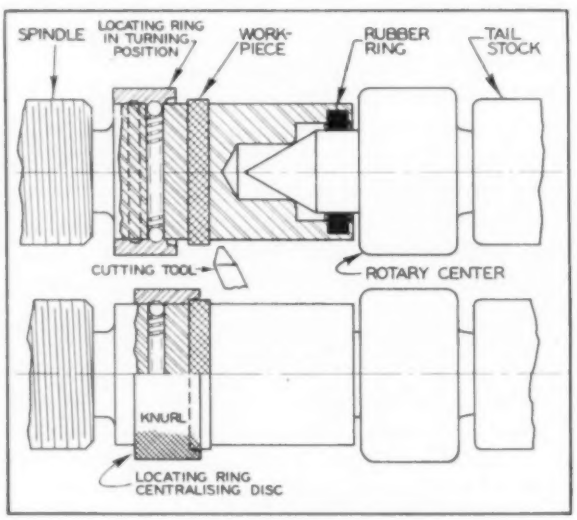
An easy way to keep rolled-up blueprints or tracings from rolling down a drawing board, or from recoiling when spread on a desk, is to slip the roll inside a rubber mason jar ring. The tab or ear then holds the roll. When cut as shown, two rings will keep a long sheet from rolling when one section is being worked on.

Frank M. Butrick, Jr.
Chapter 38, ASTE

Turning Metal Discs

Certain classes of electrical instruments require special pole pieces where outside diameters must be accurately maintained. The discs are first surface ground to thickness, then turned in a lathe.

Flat discs without holes may be turned by clamping between holders held in the spindle and lathe tailstock. The workpiece is centered by a sliding locating ring, shown retracted in the upper illustration and on the workpiece in the lower.



As there are no holes or piercings, the discs can be held only by clamping them between flat-faced holders, one of which is held in the lathe spindle, the other in the tailstock. Pressure on the discs must be heavy so that they will not move out of position during the turning operation.

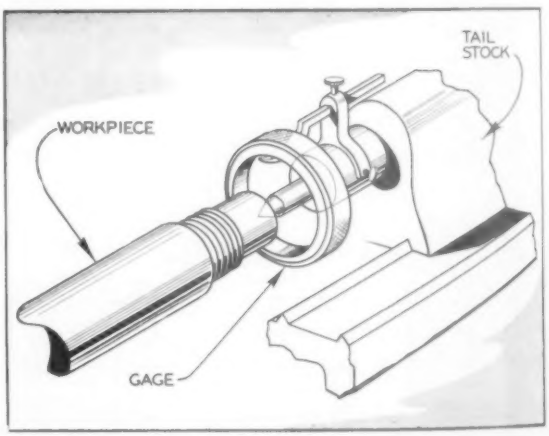
A successful setup for turning is illustrated. The rear—tailstock—holder runs on a rotary center, and is so bored that a radius provides a line contact and so permits the holder to float into alignment with the face of the discs. A rubber ring retains it in the center when backed away from the workpiece.

The driving—or headstock—holder is fitted to the spindle taper. A sliding ring centralizes the discs and after the holders are clamped together, it is retracted to provide tool clearance. The ring is retained by slightly indented annular grooves riding on spring-backed steel balls.

F. E. Riley
London, England

Ring Gage Holder

A holder for a ring gage, such as illustrated, may be clamped to the tailstock quill of an engine lathe. When turning bars, the ring gage is suspended on the holder, making it unnecessary to remove the shaft from between cutters for gaging. It also protects the gage from wear.



A holder, mounted on the quill of a lathe tailstock, serves to hold ring gages or nuts when turning or threading bars.

The holder, which is simple to make, consists of a body which fits over the tailstock quill and held in place by thumb screws. It is quickly mounted and detached. It may also be used to suspend a nut when chasing threads, the nut then being readily at hand for sizing the thread.

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Milwaukee, Wis.

Tool Engineering Report No. 5

The Milling Process—

Ramifications and Special Applications

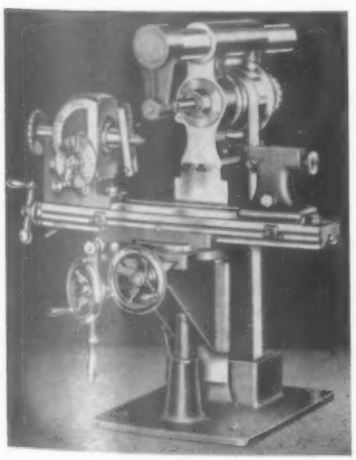
By Andrew E. Rylander

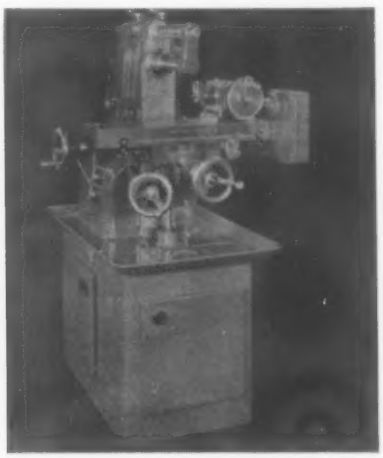
While milling is commonly defined as "a method of removing metal with a rotary cutter", such narrow definition falls rather short of its ramifications. For without question, the milling machine—the machine used for milling—is the most versatile of machine tools and, within broad limitations and further considered as a composite of several types, may be said to be the only machine tool capable of entirely reproducing itself. Other machines can only reproduce certain parts of themselves.

As a farfetched yet quite practical example, one could employ a milling machine—or, as it is commonly termed, a miller—to manufacture all of the component parts required for assembly of another milling machine. In addition to bed and table, these would include turned parts, gears, lead screws, micrometer dials and other graduated parts, cutters, and most if not all of the accessories.

True, there may have to be some compromise with conventional design, and many of the parts could doubtless be far more efficiently pro-

Milling machines range in size from small bench and pedestal-mounted models through to huge planer-type machines such as shown on the front cover. Figs. 1 and 2, at left and center, show respectively bench and base-mounted machines in the smaller class. Fig. 3, at right, shows a universal milling machine set up to mill the gashes in a worm gear hob. The three machines illustrated are knee-and-column type designed for precision instrument and toolroom work.





duced on other equipment. The point is that the end product would be an operable milling machine, and that no machine tool outside of a miller could be practically adapted to performing all operations involved.

Because applications are so broad, and so diversified as compared to other machine tools, this report will but superficially cover the general run of production work that may come within the normal range of milling operations. Such work of this nature that may be discussed will be verbally explained and with only casual reference to illustrations. In the main, we will devote this report to "specials"—that is, to applications which, if not exactly unusual, may at least be considered outside of the normal production range. The whole, then, is designed to give the student a broader insight into the possibilities of the milling machine as the master tool of metal processing.

Types and Sub-Classes

There are three basic types of milling machines: knee-and-column, available in plain or universal type; manufacturing bed-type; and special. In turn, these basic types are each manufactured in many models and capacities, and range from tiny bench models such as used for precision instrument work through to huge planer-type machines, the latter taking their name from superficial similarity to planers. Typical knee-and-column millers, both plain and universal, are shown in Figs. 1, 2 and 3.

Millers may be further sub-classified as horizontal and vertical, although either may be modified to combine the functions of both by means of swivelling vertical attachments or as a result of original design—as, for example, in the case of ram-type millers. For that matter, one could logically include horizontal boring mills, since these are often used for milling operations, especially so for large, unwieldy work. In the main, however, variations of standard machines would include the ram-type, referred to above; duplex, kellering and tracer machines; and rotary head among others.

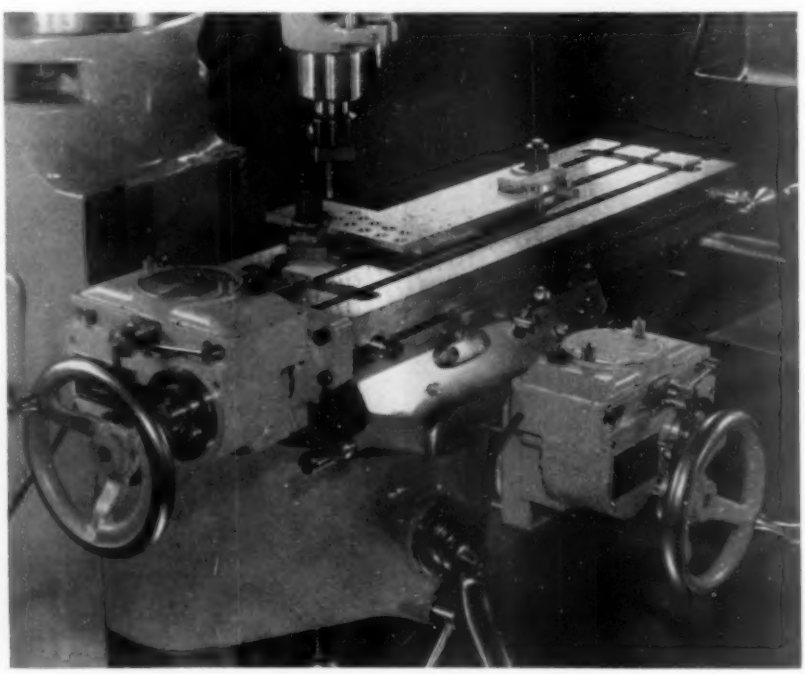
Special purpose machines would include crankshaft millers, pantograph engravers, of which an example is shown in Fig. 20, continuous rotary or "merry-go-round" and other single-purpose machines especially designed for mass production of specific parts. These too would range in size from small bench machines through to such colossi as aircraft skin millers, of which an outstanding example was shown in July issue, *The Tool Engineer*, Tools of Today section.

Of all types, the universal miller—which embodies a swivelling table in addition to other refinements—is the most versatile and, while generally considered as a toolroom machine, is equally adaptable to manufacturing. Within limits of power and table capacities for work-holding, and assuming a judicious selection of attachments, it will perform most if not all of the operations possible with other milling machines, the specials included.

Among a practically unlimited range of applications may be mentioned the cutting of gears of all types—spur, spiral, helical, bevel, worms and worm wheels, internal and racks; thread milling; slotting and shaping; manufacture of all kinds of milling cutters, including form cutters; master tools; and drills and reamers. A number of such applications are shown in the various illustrations and further explained in the captions.

Boring and Grinding

Jig boring, on both the plain and universal toolroom millers, may be performed to limits of tolerance only exceeded by ultra-precision jig borers. For that matter, accessory appliances are available which permit jig boring to precision standards heretofore considered unattainable on the milling machine. Among the most outstanding of these appliances are the so-called "Coordinators"—Fig. 4—which attracted marked attention at the 1950 ASTE Tool Show.



Coordinators, here shown mounted just ahead of the hand traverse wheels—Fig. 4—incorporate previously recorded cylinders which provide a pattern of hole location in a workpiece. These locations precisely duplicated during jig boring and compensate for any errors in the lead screws. Reproduction is exact.

These coordinators—shown mounted just ahead of the traverse hand wheels—are mechano-electrical devices which incorporate the basic idea of making records of hole locations on cylinders; thus, a complete pattern of locations can be previously recorded and later duplicated. When lead screws are not sufficiently accurate, or where use of verniers or other measuring devices preclude attainment of the "split tenth", boring or other cutting tools may be precisely positioned in relation to the work by the reproduction of sound. The result is extremely accurate.

Yet another attachment of comparatively recent development—shown in Fig. 5—permits jig grinding on the miller to precision tolerances. Provision is made for vacuum removal of abrasive dust and grinding chips; consequently, there is little danger of damage to the machine as a result of foreign matter getting into the bearings or slide ways. For maximum visibility of the work, the device is preferably used in connection with a vertical miller.

Accessories and Attachments

Attachments, usually used in connection with knee-and-column millers, include vertical heads, either plain or universally swivelling; high-speed milling heads; rack cutting attachments; manually and power operated rotary and index tables; plain index and universal dividing heads; slotting attachments; precision measuring devices; and so on through a wide assortment including flywheel arbors, chucks, vises and other work-holding devices. All told, these appliances combine to make the milling machine the truly universal machine tool.

Shown in Fig. 6, for example, is a plain swivelling vertical head, here set in horizontal plane and used in combination with a dividing head for drilling and boring of a workpiece held in a 3-jaw chuck. The drill is held in a draw-in type collet. Fig. 7 shows a manually-indexed rotary table, and Fig. 8 a tilting table attachment and swivel vise set up for angular milling. The two latter attachments are used in connection with a Swiss-type miller.

Fig. 5, showing an air-operated grinding attachment which, mounted in a milling machine spindle, permits precision jig grinding. A vacuum system keeps work and machine free of abrasive dust and grinding chips.

Cutting Tools Determine Applications

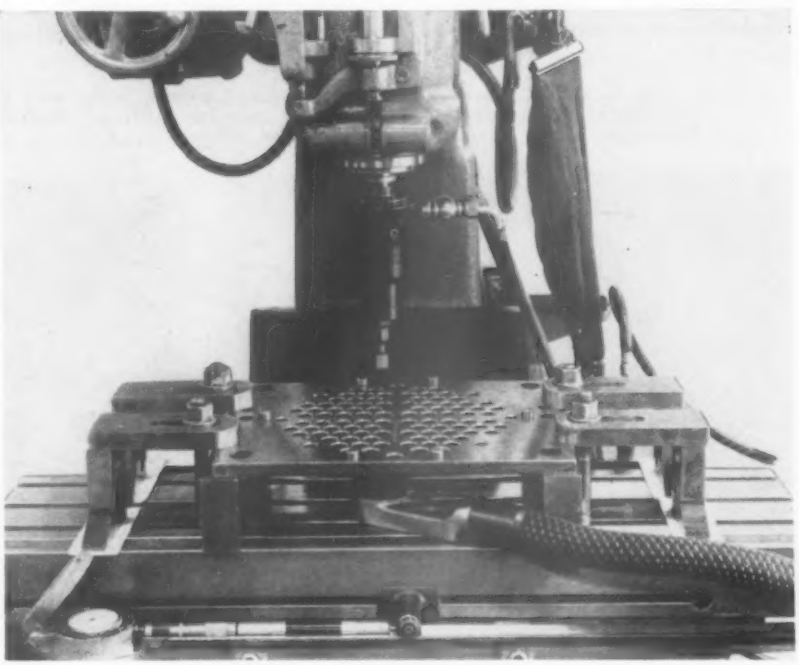
As with all machine tools, the range of applications is largely determined by the cutting tools. In the case of milling machines, these are mainly rotary cutters ranging from fractional-size end mills and engraving tools through to face mills several feet in diameter. The cutter shown in Fig. 9 may be considered a happy medium between extremes. Milling cutters are further available in about every conceivable profile from straight face through to intricately shaped single or ganged formed cutters. Among the simpler of the latter, although precision-made, may be mentioned rotary gear cutters.

To this list may be added fly cutters, usually used for experimental work or limited production runs, and also for routing; single-point tools such as used for jig boring; slotting and shaping tools, and even plain turning tools. Also included are precision boring and facing heads, of which the tool shown in Fig. 10 is an excellent example. Except as they may be mentioned in connection with specific applications, however, it is not proposed to enter into detailed discussion of milling cutters in this report.

The "How" of Milling Applications

Having sketchily outlined the "what and why" of milling procedures, we will now present the "how" of applications which, as previously intimated, deviate somewhat from straight production work. In this connection, it may be pointed out that some of the applications have been selected because of their bearing on the statement that the miller is the only machine capable of reproducing itself. Mainly, however, the choice is prompted by a desire to guide the student in the solving of the more unusual milling problems.

Reference to the front cover, for instance, will show how the milling machine may be employed to manufacture the heavier components of another miller—as, for example, a



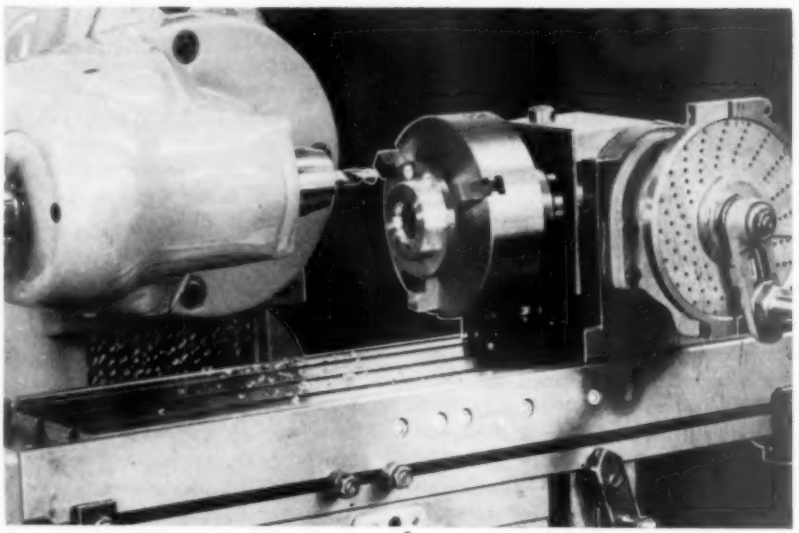


Fig. 6, showing a plain swivelling type of vertical milling head, here set in horizontal plane for drilling and boring a chuck mounted workpiece. The attachments, as well as the miller, are high-precision tools.

bed, column, knee, or table. True, such parts are preferably manufactured on a planer, due in part to the preferred straight-line tool marks which permit easier scraping, and also because plain surfaces as well as dovetails may be planed at the same setting of the workpiece and with only nominal change of cutting tools. Nevertheless, these parts can be profitably produced on the miller.

Figs. 13, 14, and 15 show how a miller may be adapted to turning and boring operations which, ordinarily, would be done on a lathe. While there is no actual economy in such substitution, there are nevertheless instances when it pays off. For instance, it may be desired to bore, turn or face a part—as, for example, a fly wheel—the diameter of which is too large for any lathe available in the plant, yet short enough to swing between the table and column of a miller, with the knee in lowered position. In such cases the miller will pinch hit for a gap-bed lathe.

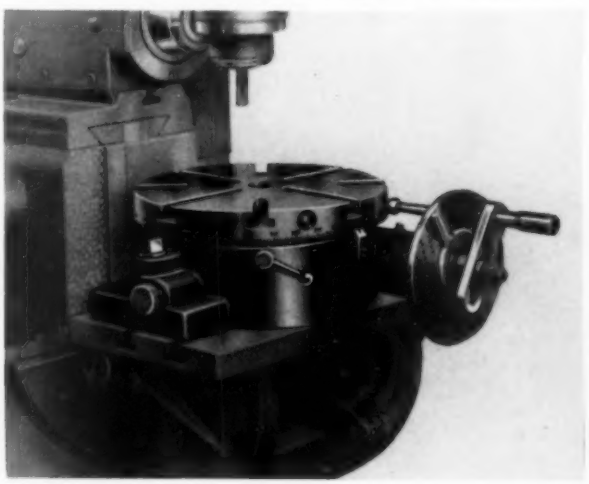
By reversing the setup shown in Fig. 13—that is, swinging the part in a dividing head between table and column—one may mill spiral or annular grooves in the face of the part, or bore a series of equally or oddly spaced holes along with other indexing operations. In such case, however, the periphery of the part should be clamped to an angle iron with each index, to prevent backlash or spacing errors which would multiply with increasing work diameter.

Gear Cutting

As previously stated, gears of all kinds may be cut on the miller. The setup for milling a spiral cutter, Fig. 11, is practically identical with that for cutting a worm, lead being determined by gearing ratio between table feed and the universal dividing head. This would also apply for the spiral routing suggested in Fig. 20, where the dividing head would be set in vertical plane and the routing done with a vertical milling attachment. A setup such as the latter is particularly applicable to experimental work, and particularly with regard to "trial horses" on certain classes of what may be termed defense work.

Fig. 19 shows a setup for cutting

Fig. 7, at left, shows a manually-operated rotary table, and Fig. 8, at right, a tilting table attachment mounting a swivel vise for angular milling. Both illustrations show a precision Swiss-type miller mounting a high-speed vertical head.



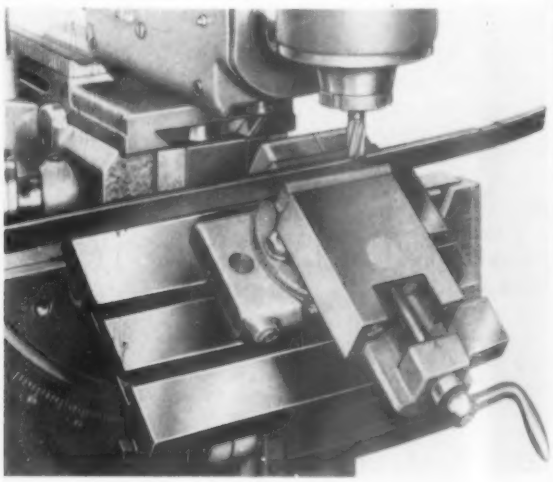
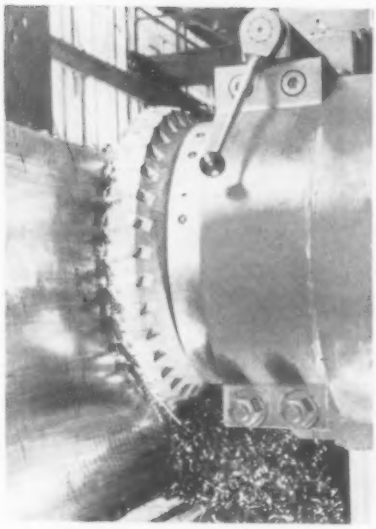


Fig. 9, at left, shows carbide milling of die blocks having a hardness of 300-375 Brinell with a 24 in. face mill mounted on an openside miller. With this carbide-insert cutter, cuts 22 in. wide are taken at high surface speeds and high feed rates.

Fig. 10, at right, shows a precision boring and facing head having a wide range of applications including straight and taper boring, recessing, undercutting and even threading. This is but one of many types of special milling cutters.



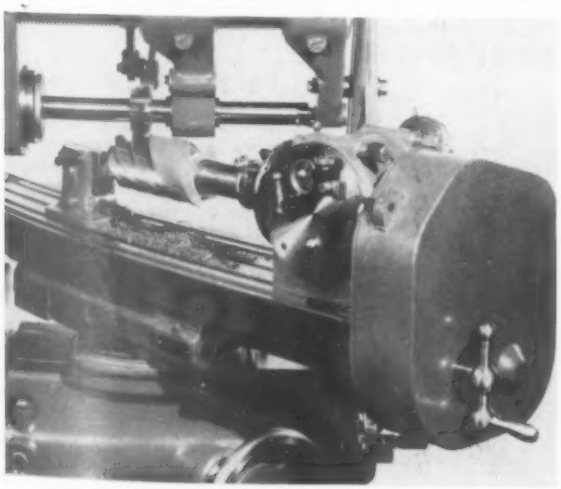
bevel gears on the miller. The dividing head is tilted to the dedendum or root angle of the tooth, and the cutter offset so that, in cutting any one space, a line drawn along the flank of the tooth at the pitch line will exactly coincide with the center at the apex of the cone. All spaces are cut at this setting; then, the cutter is offset in the opposite direction and a cut taken on the opposite flank. When all teeth have been cut, pointed test rods, laid in opposing spaces, should exactly meet at the center.

This method is inferior to generating in a bevel gear shaper because it is impossible to maintain a uniform tooth form with a rotary cutter. Therefore, the mating gears must be "dressed" after cutting to permit free rolling. This may be done by applying prussian blue to the teeth and rolling them together to mark interferences, which are then filed off. Rotary cutting of bevel gears is therefore not recommended except where conditions would preclude gear shaping—certainly not for mass production of precision bevel gears.

Racks may be cut in the miller by use of a rack cutting attachment, as suggested by Fig. 17. Indexing may be done with the table lead screw, using the micrometer dial to determine pitch spacing; however, special rack indexing attachments are available. The table should be locked for each pass. Internal gears may be cut by using a slotting attachment in connection with a dividing head, as shown in Fig. 18. Here, each space is cut complete instead of progressively, as with a gear shaper.

Worm wheels, in turn, may be cut either by continuous rotation of the index head, geared in relation to the revolutions of the machine or attachment spindle; or, each space may be gashed to the correct angle, after which the wheel may rotate free, the hob acting as its own worm

Fig. 11, at left, shows how a form cutter is used to take a roughing cut on a 6-tooth arbor-type helical milling cutter. The machine is a universal miller. Fig. 12, at right, shows a gang of cutters "climb" milling a workpiece. A plain milling machine is indicated.



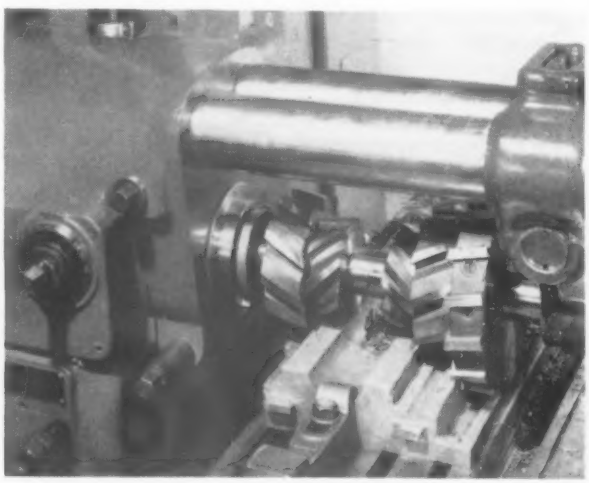
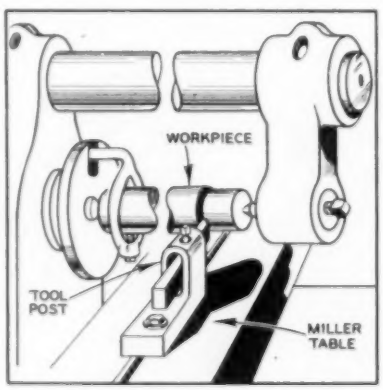


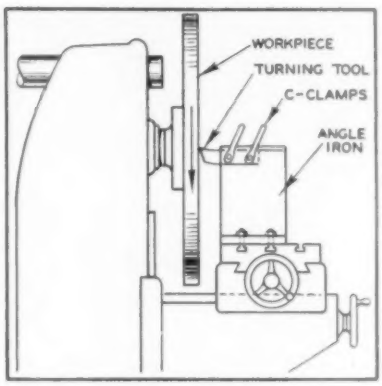
Fig. 13, at left, shows how large work may be turned or faced on a milling machine by swinging it between the table and the column. Depending on diameter of the work, the turning tool may be held in a vise or clamped to an angle iron, as shown. Fig. 14, at right, shows how work may be chucked or otherwise held for boring. Here, the tool is held in a vise. In either case, the miller is used as a lathe.

for rotary feed of the wheel. From all this, it will be apparent that any gear related to the operation of a milling machine—or, for that matter, any machine—can be cut on a milling machine. Even the micrometer dials may be graduated, using a dividing head.

Referring again to Fig. 18, the slotting attachment may be used for internal shaping of dies and other tools; also for such work as shaping the external profiles of punches, the cutting of keyways and other plain as well as intricate shaping. A possible disadvantage is its comparatively short stroke as compared to a shaper or slotting machine; however, this disadvantage is more than compensated by its tool work applications.

Fig. 16 also shows how the miller may be used as a shaper, in this case for the manufacture of formed master cutters which, in turn are used in the manufacture of formed rotary cutters. A master form tool is suggested by the sketch in upper left, Fig. 16. A fly cutter is first made, the contour or profile of which would exactly coincide with the profile of the rotary cutter.

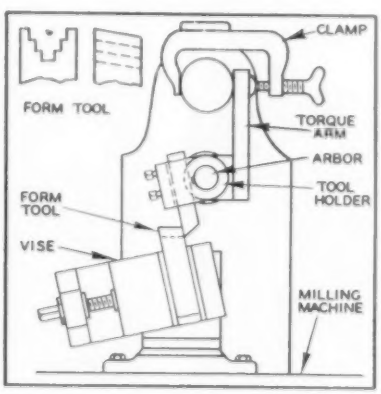




In setting up the machine, the form tool to be made is clamped in a vise or other tool holder, and tilted to the correct rake angle. The fly cutter is clamped in a tool holder and mounted on the milling machine arbor which, in turn, is locked to prevent turning. It is tilted to the same angle as the form tool, which has been previously roughed out, leaving a few thousandths for finishing. With the tools lined up, the table is then manually reciprocated for each pass until the master form tool has been planed to final shape. To prevent damage to the fly cutter, the table is dropped for each return stroke of the table.

Climb Milling vs. Conventional Milling

With further regard to milling cutters, it may not be amiss to briefly mention the advantages of down or "climb" milling over conventional or "up" milling—that is, for certain applications. Such a setup is shown in



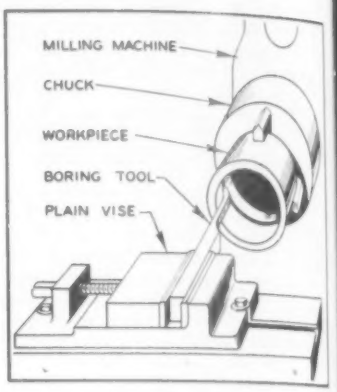


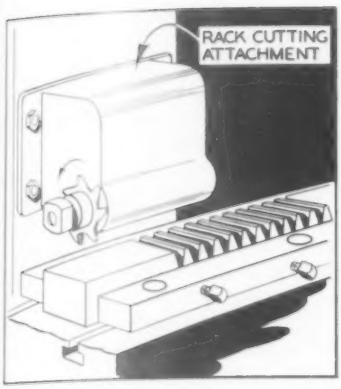
Fig. 12. The main advantage of climb milling is that the force of cutting thrust is downward, against the machine table; consequently, there is a marked reduction in the vibration and chatter often incidental with up or conventional milling.

For successful climb milling, however, it is essential that the machine have inherent rigidity and that feed screws and other components have a minimum of backlash. Feed screws should also be of ample proportions to resist torsional strains and bending under load of cut and feed. In this connection, it may be pointed out that, in face milling on a horizontal miller, best results are obtained with the cutter rotation downward against the table.

There are reasons for the latter recommendation. The more rigid the machine, and the more a cut can be directed downward against the table or inward against the machine column, the less the tendency toward

Fig. 15, at left, shows how bar stock may be turned in a miller. The workpiece is held between centers as in conventional lathe practice. Tapers may be turned by slightly offsetting the arbor center; or, the table of a universal miller may be swivelled to suit the desired degree of taper.

Fig. 16, at right, shows how the miller may be used as a planer in the making of master form tools, as indicated at upper left. The master tool is held in a holder clamped on the arbor and kept from turning by means of an arm clamped to the overhead arm. The table is manually reciprocated.



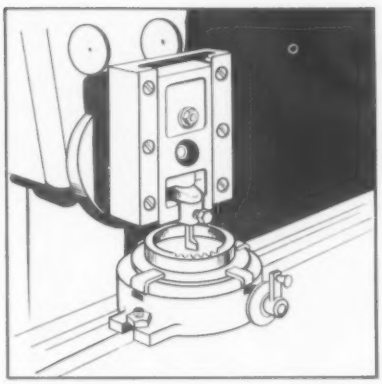


Fig. 17, at left, shows a rack cutting attachment for cutting racks on a miller. Indexing is done with the lead screw, the table being locked for each pass. However, special indexing attachments for rack cutting are available. Fig. 18, at right, shows a slotting attachment in combination with a plain indexing table, for cutting internal gears.

vibration and chatter and the greater the potential toward high surface speeds and heavy feeds. These factors are among the "musts" in mass production.

While there is a marked trend toward the use of jig borers for the boring of bushing plates and other accurate hole spacing, it so happens that many plants, both large and small, do not include jig borers in their tool inventory. In such cases, jig boring must either be contracted to an outside concern or done in the plant on a milling machine.

Without any commitment as to the preferred procedure, it may be pointed out that, given an accurate miller, an expert operator can usually turn out a job of jig boring that is accurate enough for the general run of jig and fixture work. Depending on the desired accuracy of hole spacing, one may use the table traverse screws, gaging with the micrometer dials, to determine hole location, or, where accuracy of lead screws is questionable, take readings on vernier scales.

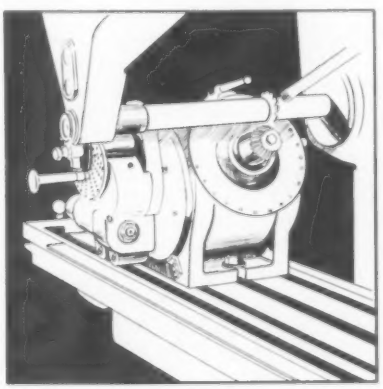
Better yet, one may use end measuring rods in combination with a micrometer head or a dial indicator, as suggested in Fig. 5. This method permits hole spacing to generally acceptable tolerances. For maximum accuracy, however, and depending less on the skill or discretion of the operator than on the measuring device itself, one may use coordinators such as suggested by Fig. 4. Again, it is not implied that the milling machine take the place of the jig borer; it will, however, serve the purpose and with commendable results when the latter tool is not available.

Relative Accuracy

A question may be raised regarding the relative accuracy of the various types of millers. In this connection, it may be said that all millers are built to relatively close limits of tolerance; however, one would not reasonably expect the same ultra-precision in a planer-type machine built for heavy work, or a plain miller designed for mass production, that one would demand in precision toolroom machines such as shown in Figs. 1, 2, and 3. Nevertheless, the large openside miller shown on the front cover is designed for accuracy of plus or minus 0.001 in.

Essentially, the miller is a stock removing tool, and accuracy is largely determined by the nature of the work and type of machine. Where, for example, a roughing cut is taken at high surface speeds and with coarse feed on a manufacturing-type miller, tolerances to near-fractional dimensions may be "good enough" and serve the purpose of both economy and requisite accuracy. Where, on the other hand, a finishing cut calls for a high degree of surface finish and close dimensional accuracy, tolerances of plus or minus 0.0001 in. and even closer may be attained on precision millers, depending on the skill of the operator.

Among factors bearing on accuracy are the cutters and accessory attachments, previously referred to, and special fixtures and work-holding devices. For no matter how inherently accurate the basic tool—that is, the machine—the end result can be no more precise than what may be termed the weakest link in the chain. Thus, while a sine fixture would provide angular accuracy to within minutes of a degree, a poorly oriented swivel or tilting vise may deviate considerably from desired angularity.



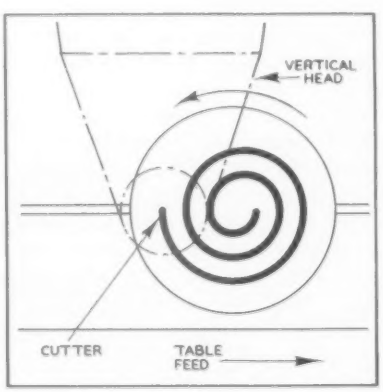


Fig. 19, at left, shows a setup for cutting bevel gears, and Fig. 20, at right, a diagram showing how spirals may be cut on a miller. In the latter case longitudinal feed and rotation of the index head are coordinated same as for cutting of worms or spiral gears. The diagram would suggest a trial setup for routing of shell fuses.

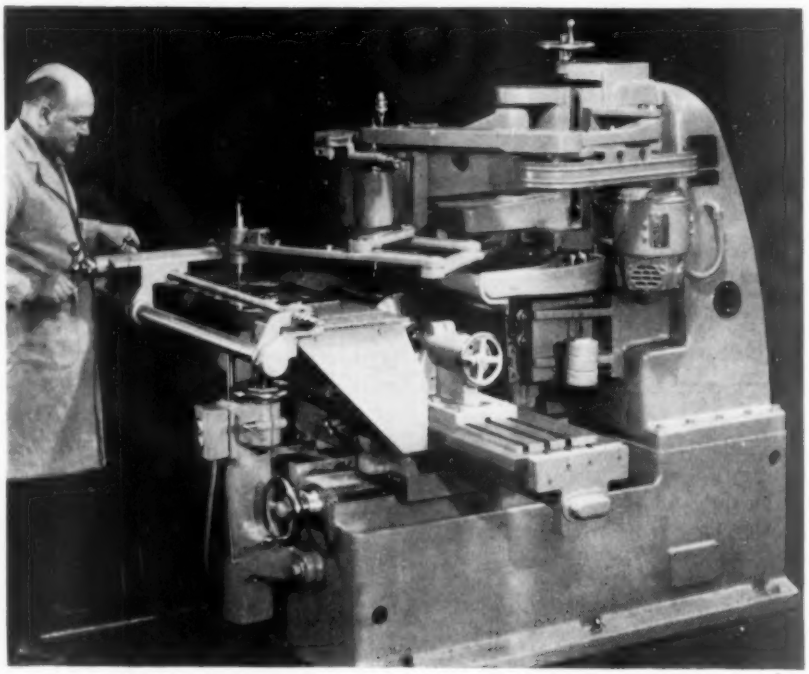


Fig. 21, showing a pantograph roll engraver for milling, routing and engraving completely every sense of the word, this machine nevertheless approaches around rolls. While a miller in the special class.

While any lengthy discussion of milling fixtures is beyond the scope of this report, it may be pointed out that they play a stellar role in both the economy of milling and the accuracy of the parts being processed. For even though a miller may be inaccurate as a result of wear or indifferent maintenance, a judiciously designed fixture that combines rigidity with initial accuracy may often out-balance looseness in the machine spindle and bed ways. Here, of course, we are referring to manufacture of parts in quantity, not to precision tool work.

Indexing Tables For Mounting

Previous mention has been made of indexing tables. Mounting two or several fixtures, these tables may be used to markedly increase the productivity of a miller since parts may be loaded and unloaded at one station while another presents the work to cutter. For that matter, the fixture could shuttle or index so that, on a second pass and with only the one handling, an opposite face could be milled with the same cutter. This phase of milling procedures may be expanded on in a later article.

There is often a fine dividing line between the standard and special milling machine inasmuch as the latter may be termed standard once it is universally accepted by industry. Thus, the crankshaft miller, which was a special when first introduced, may now be classed as a standard although single-purpose machine that has effected marked economies in the automotive and aircraft fields. Also in this class may be mentioned kellering and other profiling millers which embody all of the essential elements of standard machines with the addition of tracer duplicating devices.

On the other hand, a miller designed for mass production of one specific part and no other, and which will not be duplicated except as certain units may have been standardized for use on other special equipment, is a special machine in the fullest sense of the word. As examples of these specials may be cited continuous rotary machines, where parts are loaded and unloaded at one station and continuously fed, and even certain types of transfer machines which provide for all milling operations on a part to be done during travel past the various units.

Based on that reasoning, the pantograph roll engraver shown in Fig. 21 may be termed a special; that is, it is especially designed to mill, rout and engrave completely around cylinders and rolls. Indicative of the role that the composite miller plays in modern manufacture, this "special" serves both widely diversified as well as related fields such as the paper, printing and rubber industries—in fact, wherever rolls are used to press, stamp, print, emboss and die cut various materials.

Summing up, the milling machine will lend itself in part or *in toto* to practically any phase of metal processing possible with the general run of machine tools, including a number that have not been mentioned in this report. It is equally applicable to simple as well as complex jobs, is available as a plain hand miller or as a full automatic, and its versatility is only limited by the ingenuity and skill of the user.

Bibliography

"Fundamentals of Tool Engineering," A. E. Rylander, *The Tool Engineer.*
The Tool Engineers Handbook

Credits

Ames Precision Machine Works
Benzon Machine Company
Brown & Sharpe Mfg. Company
George Gorton Machine Company
Hardinge Brothers, Inc.
Carl Hirschmann Co.—the Schaublin miller
Ingersoll Milling Machine Company
Marvin Machine Products, Inc.
Karl A. Neise
Vulcan Tool Company

Cover

This month's cover shows an Ingersoll adjustable rail milling machine set up for milling a large bed casting. The machine, which weighs 180 tons, is powered by a 100 hp motor.

Another Tool Engineering Report is scheduled for November issue, *The Tool Engineer*.

Ordnance Tooling Will Keynote South Central Meeting at Evansville

Pentagon General to Report on New Methods, Plants Offer Tours, Board Will Meet; Membership Banquet, Handbook Awards Planned for October Weekend Conference

DEFENSE PRODUCTION tooling, a forum on advancing the tool engineer's professional prestige, plant tours, a round table to thresh out Society problems, and a banquet will point up the program of the ASTE South Central area meeting, at Evansville, Ind., October 19-20.

C. H. Thuman

Gen. M. H. Davis

On those days tool engineers will gather at the Hotel Vendome from St. Louis, Dayton, Cincinnati, Peoria, Indianapolis, Nashville, Louisville, Decatur, Springfield, Ill., Richmond, Muncie, and Evansville chapters.

Charles H. Thuman, Evansville chapter chairman, heads the committee, made up of chairmen of all chapters in the area.

Davis to Talk on Defense Tooling

Gen. Merle H. Davis, Chief of the Ammunition Branch, Industrial Division of Army Ordnance, will come from Washington, Saturday morning, the 20th, to talk about "Tools and Methods for Defense Production."

Simultaneously there will be a round table of national officers, committee chairmen, and chapter officers or their representatives. This meeting will be devoted to an open discussion of Society problems at all levels.

Friday morning, the 19th, Servel, Inc. and Bucyrus-Erie Co. will open their plants to the visitors. Along with its refrigeration and air conditioning manufacturing, Servel is tooling up to make steel cartridge cases, and wings for F-84 Thunderjet fighter planes. A new plant to house wing production facilities is being completed.

At Bucyrus the ASTE party will watch the building of earth moving equipment such as excavators, power shovels, clamshell buckets, dredges, draglines, and cranes.

Gillespie to Tell Carbide Advances

"Developments in Carbide Tools and Dies" will be presented at 1:30 that afternoon by J. S. Gillespie, manager of production sales for Carboloy Department of General Electric Co., Detroit.

This lecture will be followed at 3:30 by a panel discussion on "Raising the Tool Engineer's Professional Status." Roger W. Wallace, chairman of the Springfield, Ill., chapter and technical superintendent of Sangamo Electric Co., will be moderator.

The panel will be composed of six members from the participating chapters. They will represent the administrative, superintending and managing functions both in diversified mass manufacturing and in machine tool and cutting tool production.

Members in the area may send advance questions for discussion to: Roger W. Wallace, 1930 N. Sixth St., Springfield, Ill. Questions will also be invited from the floor.

Frank C. Hockema, vice-president and executive dean of Purdue University, Lafayette, Ind., will address the banquet Friday evening. He will tell tool engineers how to put themselves across effectively and dynamically to their companies and in the profession.

Taught Personality Development

Dr. Hockema is a Purdue engineering alumnus widely known in Indiana industrial circles. During 15 years' service as professor of management he conducted extension classes for factory personnel and executives. He has made several outstanding studies in educational and industrial fields.

The board of directors will open their semi-annual meeting Friday morning.

The committee in charge of the Evansville area meeting works on arrangements. From left: Bernard Pampe, secretary; Clyde Yost, technical division chairman; Paul Vierling, general division chairman; Henry Pernicka, general vice-chairman; Monroe Ringis, constitution and by-laws chairman; Charles H. Thuman, general chairman; Russell Wyberg, program chairman; John Race, banquet arrangements chairman; and Arthur Ullman, budget chairman.

continuing on Saturday if necessary to complete the agenda.

At each of the three technical sessions four copies of the "Tool Engineers Handbook" will be awarded as attendance prizes. But the winners or their representatives must be present at the conclusion of the session in order to receive these awards.

An interesting program also is being planned for the entertainment of ASTE wives attending the meeting.

Chairman Thuman is assisted by Henry J. Pernicka as vice-chairman.

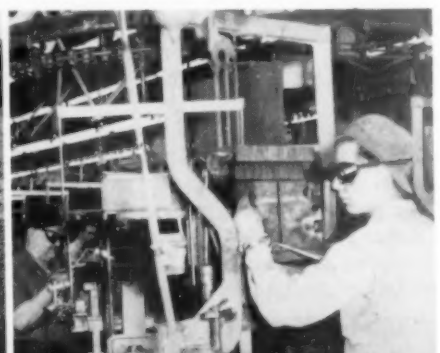
Howard McMillen, Frank Hausfeld, and Walter Schneider serve as an advisory committee.

Other local committeemen are: Technical division, Clyde Yost, chairman, and Harry Ferguson, plant tours; social division, Walter V. Stippler, chairman; Harry Newcomb, banquet speaker; John Race, banquet arrangements; Joseph Novak, banquet entertainment, and Walter Messick, ladies activities.

Paul W. Vierling heads up the general division. His committee chairmen are: Joseph Halbig, registration; Roy Ackerman, reception; Joseph Waltman, signs and tickets; Arthur H. Ullman, budget; Ralph Gordon, photography; Adam Linegar, film projection, and Bernard Pampe, correspondence.

Invitations, programs, hotel and banquet reservation forms will be mailed from national headquarters to all members in the South Central area. Registration fee is $1.00. Requests for reservations will be cleared through Mr. Thuman. Visiting invitations also will go to Atlanta and Piedmont chapters.

A substantial percentage of the membership concerned is expected to take advantage of this opportunity to attend a Society convention practically at their doorstep.



Left: ASTE'ers attending the South Central area meeting at Evansville will have an opportunity to see bullgraders and other earth moving equipment under construction at the Bucyrus-Erie plant. Right: Refrigerator unit welding is one of the operations to be inspected at the Servel factory.

Rylander Leaves *Tool Engineer* as Technical Editor

Detroit, Mich.—After Technical Editor A. E. Rylander signed "Andy" to his column this month, he put the cover on his *Tool Engineer* typewriter for the last time.

From now on he'll be concluding his Andygrams, getting engineering stories and representing the Society's national headquarters, on the West Coast, where he expects to settle with his family.

A. E. Rylander

With nearly half a century of tool engineering behind him, Andy intends to take things a little easier "for the next 40 years." He may build himself the house he has on the drawing board, probably in the Walnut Creek section of the San Francisco Bay area.

Meanwhile he'll dust off his little Remette and start pounding out impressions in his philosophical style. He may do a bit of free lance writing, too, and some consulting engineering. And he wants to paint (fine art that is), and learn to be a shutterbug, besides getting at a lot of gadgets he's never had time to work out.

A tool engineer "natural," Andy got into metal working when he was six. At that age he came from Sweden and started helping after school in the family sheet metal shop at Providence. Goodson Electric Ignition Co. signed him on as an apprentice at 13, and three years later he became a journeyman in Brown & Sharpe's Gear Division.

Then he entered Upsala College to take a special science course. To gain experience he traveled as a journeyman, designing and tooling about everything from cotton pickers to textile machines.

While at Langelier Mfg. Co. he designed the first hydraulic swaging machine. "For that," says Andy, "I got a raise and the customer's engineer got a medal."

In 1922 he settled down at Detroit and began working his way around the automotive industry. Besides designing and tooling a marine engine, designing bread making equipment, automatic machines for wire manufacture, and small houses and apartment buildings.

It was 1935 when he went to Midland Steel Products Co. to improve methods for manufacturing auto frames and pressed steel products. During World War II he had charge of subcontracting, was master mechanic and acting consultant.

Along with his business activities Andy wrote for *The Tool Engineer* for 11 years before accepting a full-time assignment as technical editor in 1945.

Prior to this he had served the Society five years as national editorial chairman, plus two years in the Detroit chapter editorial post, a couple of terms as national director, and in various other capacities.

As president of the Swedish Engineering Society, the Scandinavian editor headed up the Swedish Pioneer Centennial celebration at Detroit in 1948, receiving a medal and citation from the late King Gustav of Sweden.

Following a leisurely motor trip west, Andy expects to transfer his ASTE membership from Detroit to the Golden Gate chapter.

Other News in This Issue

Chapter listings include member as well as meeting news.

Tech High School Student Wins Milwaukee Scholarship

Walter Behrend (right), Milwaukee chapter chairman, congratulates Ronald A. Witt of the Boys Technical High School on winning the chapter's third annual scholarship. Looking on at left are: Fred Ziegenhagen, principal of the school, and Roy Radtke, chapter education chairman. The Scholarship Committee plans to increase the number of awards each year.

Five Students Win ASTE Memberships

Evansville, Ind.—Five outstanding members of the Evansville College Engineering Club were awarded a year's membership in ASTE at Evansville chapter's June meeting in the American Legion Home at Newburgh.

The recipients are: George J. Majernik, Howard E. Blesch, Edwin A. Seibert, Lynn Brown, and Walter Shaw. They were selected by a Mr. Stigers and the college engineering department, headed by Dr. John Kronsbein.

A photograph of the five young men was published in the August issue of *ASTE News*.

For several years the chapter has been granting student memberships as part of its educational program. Through this affiliation the sponsors hope that the engineering students will benefit by actual association with practicing engineers, in a broadened viewpoint, and from contact with prospective employers.

The Education Committe, composed of Paul L. Wetzel, chairman, Frank Ashman, and Louis Rothert, handles this project.

Elected Board Chairman

Windsor Locks, Conn.—Donald B. Gunting, former president of E. Horton & Son Co., was elected chairman of the board at a recent meeting of the company's directors.

Mr. Horton is immediate past chairman of the Hartford ASTE chapter.

Mick Is Chief Engineer

Hillsdale, Mich.—Douglas E. Mick of the Waterloo Area ASTE chapter has accepted a position as chief engineer for Allied Products Corp., Plant 4, Hillsdale.

For the past six years Mr. Mick has been plant engineer at Kiddie Brush & Toy Co., Jonesville, Mich. Earlier he was associated with Buick Motor Div. of General Motors Corp.

Waindle Asks Educators To 'Condition' Engineers

Lansing, Mich.—Roger F. Waindle, second vice-president of the Society, recently addressed the American Society for Engineering Education during its annual meeting at Michigan State College.

In his talk, "What Industry Expects of the Trained Engineer," Mr. Waindle emphasized the need for practical training and professional competence in preference to liberal arts studies.

Organizational and administrative ability, skill in human relationships, judgment and vision were other qualities Mr. Waindle named as essential.

Graduate Gropes to Find Niche

Educational institutions, he added, should take over the "environmental conditioning" process which industry has been absorbing in developing the young engineer. The graduate should have sufficient understanding of the scope of engineering activity to minimize costly mis-steps in "trying to find his niche." His knowledge of the "art" of engineering—the tools and methods of application—should enable him to step right into industry and become a useful citizen.

Industry, in turn, should help colleges to produce the kind of professionally trained men it needs. As an example, Mr. Waindle cited the lack of adequate tool engineering curricula. "Industry wants the production man, the tool engineer. Industry should write a specification and ask the college to produce—I'm sure it will," he concluded.

Industrialist Outlines Program to Fight Inflation, Morris Honored by St. Louis, at Hartford Night

Left: "There's no such thing as a free lunch," Roger E. Gay, president of the Bristol Brass Corp., tells Hartford Night audience in talk on Inflation. Right: President J. J. Demuth of St. Louis presents ASTE necktie to Ray H. Morris of Hartford. The haberdashery is St. Louis chapter's recognition for past presidents. Mr. Morris has not had occasion to go to St. Louis to receive the award so the "mountain came to Mohammed," President Demuth is saying.

Montreal Officers Attend Golf Tournament Dinner

Among hungry golfers served at the Montreal chapter tournament dinner were, from left: C. J. McDowell, first vice-chairman; G. A. Rogers, former national program chairman; J. P. Cloutier, chairman; R. B. Douglas, past president, and Samuel Pedvis, immediate past chairman. Held June 19 at the Lachine Club, the field day and dinner brought out more than 75 members and friends.

Golfers Brave Elements at Hamilton's Tenth Outing

Hamilton, Ont.—Approximately 170 Hamilton members and their guests enjoyed the chapter's tenth annual field day at Dundas Golf and Country Club, June 22.

Although occasional showers broke the record of fine weather for the previous nine outings, they failed to dampen the spirits of the more ardent golfers.

Gordon Hall conducted a horseshoe pitching contest audible over most of the course through a sound truck. Other competitions included nail driving and guessing games.

Bertrand Holbrook, Albert Jupp, and John Yorick were prize winners in the golf tournament. Jean St. Armand and James Hillyer finished first and second at horseshoe pitching.

After a smorgasbord supper, prizes were drawn. These included a wrist watch engraved with the ASTE emblem.

John Morice headed the Entertainment Committee in charge of the outing.

Waindle Is Manager Of Research Division

Muskegon, Mich.—Roger F. Waindle, former general manager of the Industrial Products Div., Elgin National Watch Co., Elgin, Ill., has been appointed manager of the Research and Development Div., Nugent Sand Co., Muskegon.

Mr. Waindle, who is second vice-president of ASTE, will develop new applications for refractory foundry sands as well as new products utilizing late technology on casting techniques.

A past director of the Society, he has served as chairman of the Fox River Valley chapter, with which he is affiliated. He is also a member of ASM, the Army Ordnance Association, the Society of Military Engineers, and the Engineering Society of Detroit.

PEORIA, ILL.—Approximately 275 picnickers brought basket lunches to Peoria chapter's annual family outing, held July 8 at the VFW Clubhouse in Morton.

Games, contests, and moving pictures highlighted the day. Refreshments were served by the chapter.

Radtke Judges in Ford Industrial Arts Awards

Milwaukee, Wis.—Roy A. Radtke, Milwaukee chapter education chairman, was a judge in the central region elimination of Ford Motor Co.'s Industrial Arts Award program, June 18, Kansas City, Mo.

Supervisor of industrial arts for the Milwaukee public schools, Mr. Radtke was one of 27 educators and professional men who selected entries from the central states for submission in the national finals at Chicago, August 10. He was chosen on the recommendation of the Industrial Arts Awards National Advisory Committee, comprised of leading educators throughout the country. He judged in the pattermaking and molding division.

Now in its second year of Ford sponsorship, the Industrial Arts Awards program is open to junior and senior high school students enrolled in vocational or industrial arts classes. Cash prizes totaling $35,000 and nine all-expense paid trips to Detroit and Dearborn, Mich., are awarded to winners.

Mr. Radtke is a charter member of the chapter and won the chairman's service pin award for 1950-51.

National Appoints Logan

Buffalo, N. Y.— Austin F. Logan of Buffalo-Niagara Frontier chapter has been appointed Western New York representative for National Tool Co., Cleveland, Ohio, the company has announced.

Mr. Logan is well known as a manufacturers agent in this territory.

Three Michigan Chapters Picnic at Lake Fenton

Saginaw Valley tool engineers entertain members of Waterloo Area and Jackson chapters with outing at Shore Acres Golf Club on Lake Fenton, near Flint, Mich. (Story appeared in August issue.)

Your Membership in ASTE Brings You 365 Percent in Returns

Do you list your Society dues as a business expense on your income report? Actually your membership doesn't cost you a cent because it returns 365 percent in professional benefits on the basis of fiscal years ended September 30, 1949 and 1950.

For every dollar the Society receives from members, including *Tool Engineer* subscriptions, it renders $3.65 worth of service. And for each dollar annually remitted by the individual member, the organization earns $3.21 from other sources.

Averaged over all grades, the national organization's income from members is $6.95. In addition to this each TE'er contributes an average of $3.35 to maintain his chapter, through allocation of his dues.

Gets $11.59 in *T.E.* Magazines

In return he takes from the national Society $5.68 worth of varied headquarters services. Although he subscribes only $1.92, he receives $11.59 in *Tool Engineer* magazine per year. At $3.35, the newest and most effective tools, machines, methods and processes are brought together at ASTE industrial expositions for his inspection. National conventions represent $1.04, after those attending have paid their registration fees.

National committees concerned with technical activities give their services for $1.87. These include the Editorial, Education, Program, Standards, Honor Awards, Professional Engineering, Handbook, and Special Research committees.

Other functional activities require another $1.08. Under this classification are: Constitution and By-Laws, Finance, Judicial, Membership, Nominating, and Public Relations committees, directors and national officers, and occasional subsidies to small chapters.

Seventy-eight cents per member is earmarked for the operation of the new block-long headquarters building at Detroit.

Through activities represented in the $25.39 expended per member, $28.67 is earned. Companies who present their products in the pages of *The Tool Engineer* are responsible for $10.78 of the per capita income; tool show exhibitors pay $8.29 per member to bring their services to the Society and to all industry.

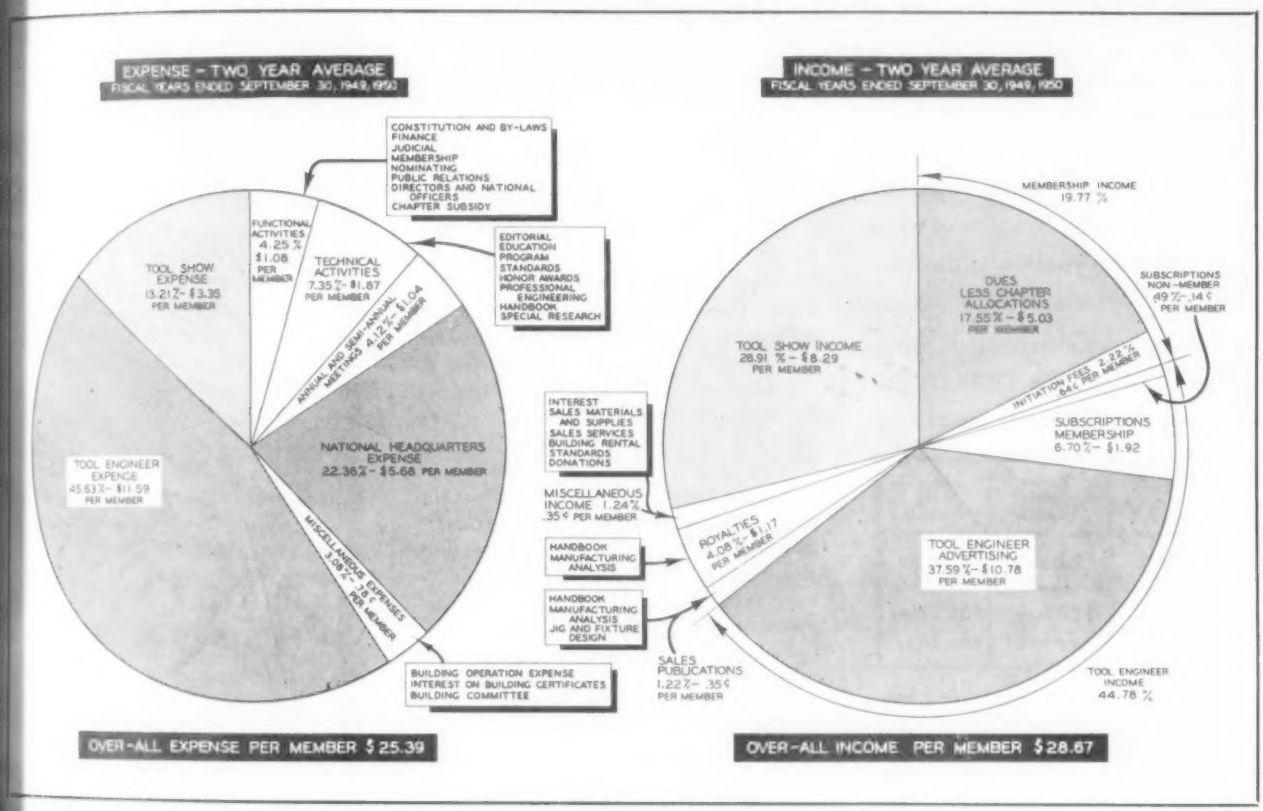
Non-member *Tool Engineer* subscribers bring in 14c. Initiation fees for processing new memberships account for another 64c.

Income from Books

Sales of technical publications such as the "Tool Engineers Handbook," the "Manufacturing Analysis" and "Jig and Fixture Design" texts, pro rate to 35c. Royalties on the first two books swell revenue by $1.17. And another 35c comes from miscellaneous sources such as interest, sales of materials and supplies, sales services, building rentals, Standards Committee activities, and donations.

So ASTE membership not only is a bargain—from a purely selfish standpoint it's something no tool engineer can afford to pass up.

The pie charts below show graphically how the Society's income and expense are apportioned, percentagewise and in dollars per member.



June Is Record Month In Membership Drive

Detroit, Mich.—One of the largest groups of applicants ever taken into the Society was processed during June, when 593 new members were added to the roster. This number included the charter membership of the Tulsa and London-St. Thomas chapters.

It boosts the membership close to 18,600, leaving a quota of only about 1400 more tool engineers, to attain the "20th year, 20,000 members" goal.

Among companies recently joining the organization, General Motors Corp. is listed as an affiliate of Detroit chapter.

Get that
NEW MEMBER
Today

Boston Heads Michigan's New Engineering Program

An Arbor, Mich.—A new program in Production Engineering is being offered at the University of Michigan, under the direction of Prof. Orlan W. Boston, chairman of the Production Engineering Department, formerly known as the Metal Processing Department. Professor Boston is a member of the Waterloo Area ASTE chapter and of the Society's Research Fund Committee.

The curriculum leading to a B.S.E. degree in Industrial Engineering includes three new courses in Structure of Metals, Design for Production, and Process Instrumentation.

Offers Wide Range of Courses

Other subjects offered are: Engineering Materials and Processes, Casting, Machining, Metals and Alloys Laboratory, Foundry—Advanced, Plastics Fabrication, Die Casting and Powder Metallurgy, Stamping, Advanced Studies in Production, Tool Design, Machine Tool Design, Welding, Gas Welding, Electric Welding, Dimensional Quality Control, Parts Processing, Machinability, and Advanced Working and Treating. A Management option also is available.

Equipment used includes 160 tools in the Machine Tool Laboratory, the university's comprehensive Measuring and Gaging Laboratory, plus the Detroit Ordnance Gage Laboratory on the campus. In addition there are extensive gas and electric welding, heat treating, and testing facilities, and a foundry with crucible, arc, and induction furnaces, and a 32-inch lined cupola.

The department expects to offer the Masters Degree and advanced graduate work in the near future.

"We look forward to an active year," says Professor Boston, "as many students majoring in allied fields are interested in this new curriculum."

Positions Available

CUTTING TOOL ENGINEER—With large manufacturer of cutting tools for field engineering service. New York and New England area. Must be thoroughly familiar with application of drills, reamers, cutters, etc. State age and experience. Also, connections last ten years. Strictly confidential. Box 239, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 21.

SCREW MACHINE PROCESS ENGINEER wanted for screw machine plant, located midway between Buffalo and Cleveland. Box 240, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 21, Mich.

Gun Drilling Speeded by Gabay's Method

During the *ASTE News* editor's absence on vacation, a story in the August issue, citing Alexander Gabay's contribution to gun barrel drilling, was cut to make room for a last-minute obituary.

Unfortunately the blue pencil left Mr. Gabay escaping the Nazi invasion of France with only the clothes on his back. To relieve the readers' suspense, the story follows in full:

Sunnyvale, Calif.—Alexander Gabay, until recently director of production for Butwin Sportswear Mfg. Co., St. Paul, Minn., has been appointed assistant to the president of Wooldridge Mfg. Co. in Sunnyvale.

Came to U. S. on Hispano Project

For 20 years before coming to the U. S. during World War II, Mr. Gabay was a plant engineer with International Harvester Co. in Europe. When France fell, he fled the Nazis with only the clothes he was wearing. At that time International Harvester had been working on blueprints for the Hispano 20 mm aircraft cannon. The British flew out some of the unfinished drawings, made improvements, then relayed the plans to the U. S. for completion.

Working with Henry Kruger, a Detroit machine tool designer, ASTE'er Gabay suggested a drill subsequently developed to cut through gun barrels in one-third of the time and with eight times the wear resistance of previous drills.

Still on the Hispano assignment, the Twin City chapter member was asked to set up a gun factory for IH, staffed with untrained workers, in a St. Paul farm equipment warehouse. The story of this achievement is one of the manufacturing sagas related in Christy Borth's "Masters of Mass Production."

Holder and Urbach Advanced by Timken

Canton, Ohio—Two Cleveland ASTE men have been promoted in appointments recently announced by A. L. Bergstrom, vice-president of the Timken Roller Bearing Co.

L. A. Holder has been made chief mechanical engineer and H. J. Urbach is now executive engineer.

With Timken since 1928, Mr. Holder, during World War II, was a member of the Engineering and Packaging Subcommittee of the War Department and held industrial and civilian defense posts.

Since joining the company in 1933, Mr. Urbach has served with the Railroad Engineering and the Diesel Pump divisions and as works manager.

Families Play, Picnic At Philadelphia Outing

Philadelphia, Pa.—A morning r was no deterrent to the gay group 350 Philadelphia ASTE'ers, famil and friends who attended the sixth a nual outing at the Philadelphia Ri Club, June 2.

Clearing skies brought outd sports, including a baseball game b tween Tom Donovan's "Bums" and R Griffith's "Tigers." Another gro played bingo on the porch.

Dinner and the awarding of mo than 100 attractive door prizes we followed by a floor show and dancing.

It was the final chapter activity un the Executive Night to be held Sep tember 20.

Joe Jovinelli on the accordion and Andy McMillan at the small end of the trumpet hit a high note for Bill Miller at Philadelphia's outing. At right is Third Vice-President T. J. Donovan, Jr.

Ed Adams, Myrtle Barnes, Helen Williams, and Ted Riehl, left to right, carry off the grand door prizes awarded at Philadelphia chapter field day.

Opens Southern Office

Dayton, Ohio—H. E. Folkerth, president of Continental Tooling Service, and a member of the Dayton ASTE chapter, has announced the opening of a new company office in Atlanta, Ga.

Increased government defense contract activity in southern areas made the branch office necessary, Mr. Folkerth explains. It will have facilities for designing, tool engineering, and procurement, he adds.

Demuth Is Picnic Guest

Evansville, Ind.—J. J. Demuth of St. Louis, Society president, was guest speaker at Evansville's annual stag picnic, July 9, at the Servel picnic grounds.

After outlining the formation and structure of the national organization, Mr. Demuth made an earnest plea for all members to work to advance tool engineering as a profession.

President J. J. Demuth presents a past chairman pin to Walter V. Stippler at Evansville chapter's stag picnic.

The president also made the presentation of a past chairman pin to Walter V. Stippler.

Russell Wyberg was general chairman, assisted by Roy Ackerman, who had charge of attendance prizes, and Joseph Halbig, entertainment chairman. The outing was attended by 102 men.

Automation Cuts Handling In Car Parts Production

Ann Arbor, Mich.—Automation as applied to the manufacture of automobile generators, starters, voltage regulators, and ignition coils was observed by approximately 130 Waterloo Area members and others participating in a tour of the Ford Motor Co. Parts and Equipment Division at Ypsilanti, June 27.

Making these units on a production scale affords much opportunity for reducing stock handling between operations. In addition it utilizes special equipment such as automatic armature winding machines, multiplying hourly output of the semi-automatic machines they replace.

Made District Manager

Hartford, Conn.—W. G. Dahl has been appointed Hartford district manager by Latrobe Electric Steel Co. of Latrobe, Pa. Mr. Dahl succeeds Harold C. Cole who has resigned from the company. Until his present assignment Mr. Dahl served as a representative from the Hartford office.

Both men are ASTE members, Mr. Dahl with the Springfield, Mass., chapter and Mr. Cole with New Haven.

Jet Performance Related By Aircraft Executive

Los Angeles, Calif.—Operating prin-ciples and functions of the J-47 engine were explained by Bruce A. Willsey at Los Angeles chapter's Jan. 12 meeting at Scully's Cafe.

About 175 members and guests as-sembled to hear Mr. Willsey, manager of the Manufacturing Div., Solar Air-craft Co., San Diego, describe what makes the wheels go around in the "work horse engine" of the Air Force.

Difficulties encountered in machining stainless steel and Solar's experimental work in overcoming manufacturing problems were detailed by the speaker.

During the ensuing question and answer period, speeds, feeds and horse-power requirements were discussed. Comparison between European and American jets was of especial interest.

G. J. Walkey (left), Los Angeles chapter chairman, introduces Bruce A. Willsey of Solar Aircraft Co., jet engine speaker at recent chapter meeting.

Powell Promoted

Detroit, Mich.—Appointment of Clarence W. Powell as Pittsburgh branch manager for Carboloy Co., Inc., Detroit, has been announced by J. M. Bertotti, Carboloy field sales manager.

Since joining Carboloy in 1943, the Cleveland ASTE'er has served as sales and service manager.

Obituary

Richard F. Schulze

Richard F. Schulze, 48, president of Schulze & Burgess Co., Hazel Park, Mich., was killed June 26 in an automobile collision near Pontiac.

A native of Dresden, Germany, Mr. Schulze attended schools there and in Detroit.

Before becoming a partner in Schulze & Burgess, he was employed as a tool designer in Germany and at Ford Motor Co., Detroit. He was a member of the Detroit ASTE chapter.

Weingard Made V.P.

Erie, Pa.—Archie E. Weingard, a past chairman of Erie chapter, ASTE, has been appointed vice-president in charge of production at American Meter Co., the firm has announced.

With American Meter since 1947, Mr. Weingard has been supervisor of methods and production manager.

Kimball With Kennametal

Springfield, Mass.—Gordon G. Kimball of Hartford chapter has been appointed application engineer at the Springfield office of Kennametal, Inc.

Before joining the Kennametal sales staff, Mr. Kimball was associated with Jacobs Mfg. Co. of West Hartford.

Coming Meetings

CHICAGO—March 17-21, 1952. Tool Engineers Industrial Exposition and 20th annual Society meeting.

CLEVELAND—September 14. Cleveland Hopkins Airport. Tour through Cadillac Motor Car Div., Cleveland Tank Plant. Tour limited to 200 members. October 12. Speaker: A. T. Colwell, vice-president, Thompson Products, Inc., TAPCO Div., Cleveland.

DES MOINES—September 19. Speaker: W. C. Lee, chief quality control engineer, Solar Aircraft Co. Subject: "How Statistical Quality Control Can Assist Tool Design and Methods Departments."

DETROIT—September 13. Plant tour. Student section: September 19, Engineering Society of Detroit. Subject: "Wealth, Production and Machine Tools."

EVANSVILLE—October 19-20, Hotel Vendome. South Central area membership meeting and semi-annual meeting of board of directors. Technical sessions, plant tours, banquet.

MADISON—September 11. Speaker: Elmer R. Schroeder, Alemite Co., Milwaukee. Subject: "Oil Mist—Principles and Applications."

MILWAUKEE—September 13, 6:30 p.m., Elks Club. Speaker: Harris Ewald, chief engineer, Evinrude Motors. Subject: "Development of the Outboard Motor." Coffee speaker: Prof. Ben G. Elliot, chairman, mechanical engineering, University of Wisconsin. October 11, 6:30 p.m. Plant tour, International Harvester Co.

NEW HAVEN—October 11. Plant tour, Greist Mfg. Co.

PHILADELPHIA—September 20. Executives Night.

TULSA—October 11. Speaker: Nathan Janco, president, Centrifugal Castings Co., Tulsa. Subject: "Centrifugal Castings."

U. of I. Sponsors Conference on Tooling Problems

Urbana, Ill.—ASTE chapters in Illinois and the surrounding area are invited to attend a tool engineering conference October 27, sponsored by the Extension Division and the Department of Mechanical Engineering of the University of Illinois, with the cooperation of the Chicago ASTE chapter.

Lawrence E. Doyle, associate professor of mechanical engineering at the university and chairman of the Chicago ASTE Committee on Professional Engineering, heads up the meeting, to be held on the Urbana campus.

Prof. K. J. Trigger of the university staff and Dr. M. E. Merchant of Cincinnati Milling Machine Co. will discuss "Recent Developments and Applications of Metal Cutting Research." Dr. A. O. Schmidt, research engineer for Kearney & Trecker Corp., will be chairman.

A round table discussion of "Metal Cutting Problems" will be conducted by Harry W. Highriter, technical director of Vascoloy-Ramet Corp., William H. Oldacre, president of D. A. Stuart Oil Co., Professor Trigger, Dr. Schmidt, and Dr. Merchant. In addition Dr. Schmidt will report on the European machine tool show being held at Paris this month and will comment on industrial conditions abroad.

Prof. Charles J. Gaa of the university's Department of Business Organization and Operation will speak on "Considerations in the Depreciation and Replacement of Machine Tools and Equipment." A paper, "Electronics Applied to Machine Tools," will be presented by Prof. Gilbert H. Fett of the Electrical Engineering Department. Outstanding industrial authorities also will participate in the technical sessions.

T. J. Donovan, Jr. of Philadelphia, third vice-president of the Society, is expected to address the group after dinner.

Laboratories and other university facilities will be open for inspection during the meeting.

A program planned for the ladies includes tours of the Home Economics and Ceramics departments. In the afternoon, the women guests will go through Allerton Park, a magnificent baronial estate donated to the university by Robert Allerton. The men also may visit the park that day or the next.

The conference invitation is extended to members of Chicago, Decatur, Peoria, Rockford, Fox River Valley, Springfield, and Tri-Cities chapters, and others within convenient traveling distance, as well as to Society officers in the vicinity.

Bradford Stricken At Tulsa Chartering

Worcester, Mass.—Thomas C. Bradford, technical representative for F. E. Anderson Oil Co., Portland, Conn., and a member of the National Membership Committee, is convalescing at his home, 17 Germain, Worcester 2. He suffered a heart attack in June while at Tulsa, Okla., for a chapter chartering.

After returning to Worcester, Mr. Bradford spent a month in a hospital.

Garco Machinery Moves

Cleveland, Ohio—The staff of Garco Machinery Co. has moved into the company's new headquarters at 21000 St. Clair Ave., according to an announcement by William F. Reiff, Jr., partner.

Other Cleveland ASTE men representing Garco are : Harold L. Gardner, also a partner, Paul E. Clasen, William C. Greig, C. K. Hamlink, and Robert J. Lantz.

McKinney Promoted

Dubuque, Iowa—Earl T. McKinney, a Tri-Cities ASTE member, has been appointed factory superintendent of the A. Y. McDonald Mfg. Co. in Dubuque.

Mr. McKinney joined McDonald in 1945 and has recently been in charge of foundry operations.

News in Metalworking . . .

HANCHETT EXPANDS PLANT FACILITIES

Hanchett Manufacturing Co. recently announced completion of additional assembly space at its Big Rapids, Mich., plant. Now in its 63rd year, the plant, devoted entirely to the manufacture of saw sharpening and knife grinding machines and accessories, covers seven acres.

Production facilities of Hanchett's Portland Oregon plant also has been expanded with the installation of more than $50,000 in equipment.

BUILDS $3-MILLION TUBE MILL

The Yoder Co. is building an electric resistance-weld tube mill for the Lone Star Steel Co. Exceeding a cost of $3,000,000 exclusive of installation, the mill will handle either piled skelp or coiled strip and will have a welder of unusually high capacity.

Incorporated in the mill also will be equipment for thermal and physical processing by means of which high physical properties will be obtained.

Including the Lone Star mill, there will be a total of six large resistance-weld continuous mills in operation in the United States and Canada, five having been built wholly or partly by Yoder.

ROCKWELL EXPANDS

With expected completion this month of its new plant at Tupelo, Miss., Rockwell Manufacturing Co. will add more than 150,000 sq. ft. to its overall production and maintenance facilities.

Some of Rockwell products will be fabricated in the new plant, but it will be used as a southern service depot for many of the other products of the company.

HELI-COIL MOVES

Plant of the Heli-Coil Corp. has recently been moved to Shelter Rock Rd., Danbury, Conn. Facilities formerly were located in Long Island City.

CORRECTION

In an item published in the August issue calling attention to the contest currently sponsored by Meehanite Metal Corp., the organization was incorrectly referred to as a "Cincinnati firm". Proper address for Meehanite is New Rochelle, N. Y.

CLEARING MACHINE TO BUILD PLANT

A modern factory building addition has been scheduled for the 27-acre tract of land recently purchased in Joliet, Ill., by the Clearing Machine Corp., Chicago.

The unit will be equipped particularly for smaller and lighter operations and it is planned to divide work with the main plant on a basis which will make most efficient use of both facilities. Completion is expected early in 1952.

MORSE TWIST DRILL OPENS WAREHOUSE

A warehouse for Morse cutting tools has been opened at 5003 Navigation Blvd., Houston, Texas, according to current announcement by James Y. Scott, president of Morse Twist Drill & Machine Co. Open house celebrated the extension of the company's service to that part of the country.

LOUIS ALLIS CELEBRATES GOLDEN ANNIVERSARY

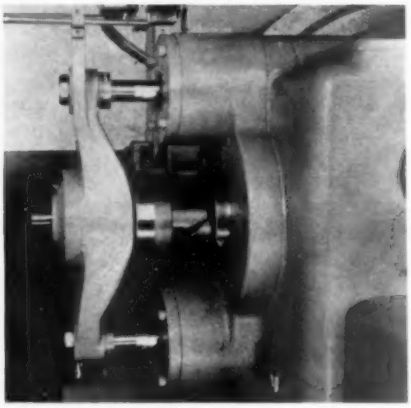
The Louis Allis Co., of Milwaukee, this year marks its fiftieth year as a manufacturer in the electrical industry.

Louis Allis, who founded the firm in 1901, was a member of the second generation of the well-known manufacturing family. His father, Edward P. Allis, a pioneer of American industry, established the Edw. P. Allis Co., which later merged with the Fraser-Chalmers Mfg. Co. to become the present day Allis-Chalmers Mfg. Co. Though the founder of The Louis Allis Co. remained in the original firm with his father until achieving the position of general purchasing agent, there has never been any connection between the two organizations.

The current issue of the company's "The Louis Allis Messenger" has been assembled as a Golden anniversary edition, telling the story of its history, activity, growth, which parallels the growth of industry generally.

Tools of Today . . . .

Michigan Tool Company Introduces High-Speed Gear Hobber



Introduced at a recent press preview, a revolutionary high-speed, high-production gear hobber by Michigan Tool Company, 7171 East McNichols Rd., Detroit 12, incorporates novel principles for faster and more accurate hob-generating of gears. The machine—shown at left above—is designed to cut gears efficiently and automatically at speeds up to 1000 rpm of the hob spindle, equivalent to about 1300 sfm, and at feeds up to ¼ in. or more per hob thread per revolution of the workpiece.

On demonstration, for example, the machine was turning out two 3⅛ in. diameter, 9 pitch, 22 tooth helical gears—total face width 2 in.—to close tolerances in a matter of 58 seconds, using a high-speed steel hob. The hobbing sequence is shown in the four photos below. At left, the two blanks are shown just before the button is pushed to start the cycle; next, 15 seconds later, the hob has completed its plunge cut and traverse feed starts; at 37 seconds—next photo—it nears the end of the climb cut; then, 58 seconds from start, the cut is finished and hob and tailstock center retract.

The machine is simple to set up and operate and, while primarily intended for high production, incorporates inherent versatility for quick changeover. If so desired, it may be adapted to automatic loading and unloading for continuous operation. Thought has been directed toward accuracy independent of operating conditions; consequently, the design indicates the rigidity so necessary to insure smoothness at all speeds. A novel mounting of gears virtually eliminates all backlash.

Travel has been reduced by eliminating all except 1/16 in. of "approach feed" of the hob. This is effected by using two distinct feeds in sequence: a plunge feed to correct depth by the hob, with its center line just 1/16 in. ahead of the work, followed by a traverse feed of the work across the hob to a point 1/16 in. past center, to complete the cut. While full utilization of maximum speed possibilities—for which the machine is designed—may have to await development of suitable carbide hobs, present development indicates practical cutting of steel gears with high-speed steel hobs at surface speeds closely approximating the so-called "carbide speeds."

Accuracy appears to be consistent and dependent on tools rather than on machine conditions. For example, lead errors are avoided by mounting the lead cam—or guide—directly on the work spindle, as shown at right above. This virtually eliminates the chance of torsional windup in the hub spindle drive. All machine movements are positively controlled and in accurate timed relation.

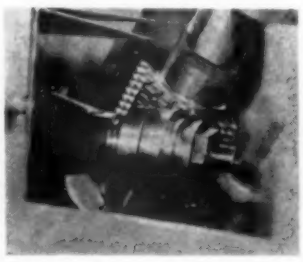
One thing, readily apparent to observers, was smoothness and lack of vibration, this due to inherent rigidity not only in the structural elements of the machine—total weight about 21,000 lbs.—but also in the operating units. Among contributing factors for smooth operation may be mentioned "Cone-Drive" double enveloping gears for index and main drive gears, and use of a flywheel to dampen torsional vibration.

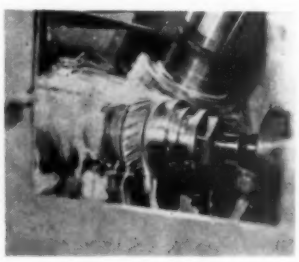
Dual hydraulic feeds tend to considerably reduce the number of gears that would ordinarily be used; and here, the hydraulic cylinders have been accurately "matched" by holding cubic contents to close tolerances. There is little if any chance of one cylinder overrunning the other. Also among interesting details is the oil-air-mist lubrication which, controlled by a solenoid, works only while the machine is in operation. While providing effective continuous lubrication, oil consumption is only about 2 ounces in 8 hours.

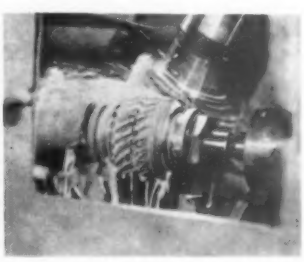
The machine is designed to handle any helical or spur gear, or spline, up to 8 in. in diameter and 4¾ in. face width. Coarsest recommended pitch is 3. Either climb or conventional hobbing can be used, as desired. All this, of course, rather sketchily describes a machine designed to effect a marked cost reduction in the manufacture of gears; however, complete details and specifications may be had from Michigan Tool Company.

T-9-841

USE READER SERVICE CARD ON PAGE 101 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION







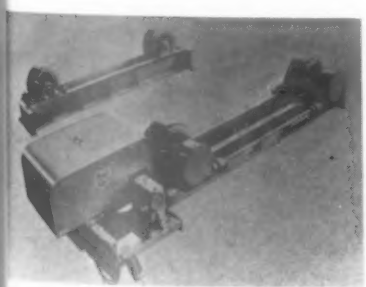
Tumbling Machine

Tumble finishing machines by the Crown Rheostat & Supply Co., 3465 N. Kimball Ave., Chicago 18, Ill., have been improved to provide added benefits to users of finishing equipment. The machines are designed for deburring and smoothing rough edges on metal parts.

A variable speed drive provides a wide choice of speeds for processing steel, die cast or other metal parts; also, an automatic timer control assures a definite operating time, thereby avoiding over or under-running of work during the finishing period. Lightweight doors with replaceable gaskets provide a water tight seal. **T-9-851**

Turning Rolls

The Model 75 PR turning roll, by the Worthington Pump and Machinery Corp., Harrison, N.J., has a carrying capacity of 25 tons. Load is distributed among three units—one power and two idler rolls—of 25 ton capacity each. By use of steel rollers and five idlers, rating may be increased to 150 tons.



The power roll is driven through an inclosed variable speed unit, providing a range of speeds to meet individual job requirements; also, center-to-center distance may be changed to handle work of various diameters. The rolls are particularly adaptable to handling large cylindrical weldments or other work requiring means of rotation during processing. **T-9-852**

Service Kits

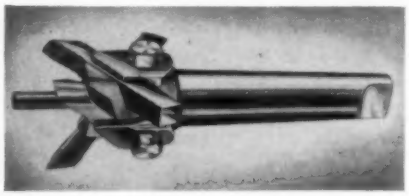
A line of twenty repair and conversion kits are offered for assistance to users of Norgren pressure regulators and oil fog lubricators by the C. A. Norgren Co. of Denver.

Fourteen repair kits are offered for Norgren Regulators Types 2A, 2AX, 2E and 2H and for Norgren Lubricators of all types, while six kits are available for converting conventional Norgren Air Pressure Regulators to Air-Relieving types and Liquid Pressure types. Kits contain from four to eleven new parts and include repair or conversion instructions with helpful cross section drawings.

Recommended by the manufacturer as a means for alleviating the resulting delays in delivering new industrial equipment and in conserving critical raw materials, the kits are designed to (1) provide the next best thing to new equipment; (2) save time and expense in waiting for new equipment; (3) reduce downtime for repairs; (4) lower repair costs; (5) improve the performance of old equipment; (6) keep present equipment in service longer; (7) facilitate conversion to meet changing production requirements; (8) simplify stock record keeping by providing one stock item instead of many to cover individual parts in a kit. **T-9-853**

Adjustable Hole Cutter

Cutting of accurate, finished holes in a single operation is claimed for the line of 3-blade adjustable hole cutters, by the Robert H. Clark Co., 9330 Santa Monica Blvd., Beverly Hills, Calif. The tools are said to cut equally well on steel pipe, stainless steel, boiler plate, hard fibre, Transite and other problem materials.



The tool is designed with replaceable cutter blades that are easy to sharpen and easy to set. The body is made of heat-treated steel with three high-speed steel blades set 120 deg apart. Pilots are removable to permit the use of lead drills.

The Clark line has a cutting range of 5/8 in. to five in. diameters, and thickness capacities from thin sheets to 1 in. While all models are designed to cut clean holes through curved surfaces, Models 4C and 5C are especially engineered for this purpose. **T-9-861**

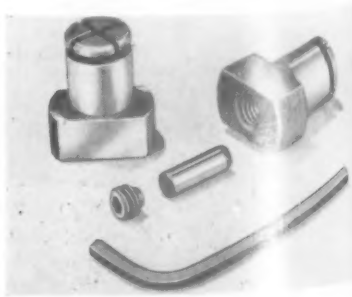
Jet Blade Miller

A standard precision profile mill—the Ex-Cell-O Style 86—for millin the airfoil form on jet aircraft com pressor blades is now available fro Ex-Cell-O Corp., 1200 Oakman Blvd Detroit 32, Mich. Outside of loadin and unloading the work, and pressin the start button, machining cycle i completely automatic. Accuracy of ai foil form is assured by master cam made directly from glass layouts.

The blades are located from a previously finished root form at one end and centered on the opposite end. Here —as a feature of the machine—the work is rigidly supported by back rests during the cutting stroke, to cancel out distortion due to cutting pressure. At the end of the work stroke, headstock, tailstock and back rests are unclamped and the work indexed. After the last cut the machine comes to rest, with the work raised from the cutter and clear for unloading. **T-9-862**

Fixture Key

A fixture key announced by the Jergens Tool Specialty Co., 712 E. 165th St., Cleveland, Ohio, eliminates the milling and other operations incidental to milling key slots in fixture base plates. Instead of milling, it is only necessary to lay out and bore two holes, insert the Jergens keys and lock them in place. As stated by the manufacturer, these Sine Fixture Keys—as they are termed—are interchangeable and self locking. Fully described in company folder SKF No. 4. **T-9-863**



Pneumatic Screwdriver

Designed for delicate work, such as assembly of instruments, a midget power screwdriver and nut runner has capacity for screws within range No. 1 to No. 8 ANF and UNC, and equivalent sizes. A reversing control suiits it to disassembly work.

Shorter than a fountain pen and weighing only 8 oz., the tool incorporates a rotor type motor running at 16,000 rpm. It is coupled directly through an impact-type clutch direct to the screwdriver bit. An automatic on-off control protects the screwhead from damage.

Air is automatically switched on when the bit contacts the screw slot, and switched off on release of pressure. Tension is adjustable, to insure that all screws of a given size may be driven to uniform tightness. Further described in company literature, available from Newage International, Inc., 235 E. 42nd St., New York 17, N.Y. **T-9-871**

Panto-Engraver

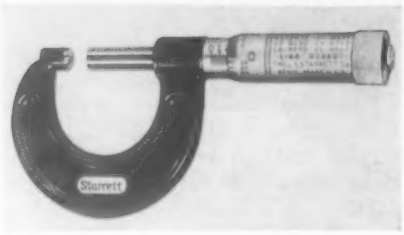
Cut-away construction of the pantograph arms of the Model UE-3 engraver, by H. P. Preis Engraving Machine Co., 279 Industrial Branch, Hillside, N.J., gives an operator complete visibility of the work and thus tends to reduce engraving errors.

Adjustment for pantograph ratios—which range from 1.7:1 to 7:1—are accomplished on cylindrical sliding members provided with improved precision markings. A positive lock enhances accuracy. The construction is said to enable an operator to engrave raised or sunken lettering, with maximum precision, into unhardened alloy tool steel in addition to other metals, and plastics. A forming guide may be used for engraving concave, convex or spherical beveled surfaces. **T-9-872**

Rounded Anvil Micrometer

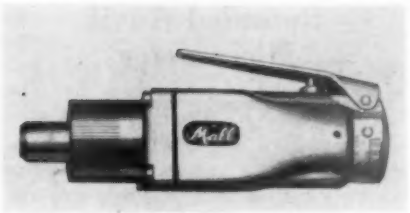
A micrometer introduced by The L. S. Starrett Co., Athol, Mass., is used for measuring the wall thickness of bearings, tubing and various cylinders having walls up to 1 in. thick and any diameter down to $\frac{5}{8}$ in. ID. Since the anvil contact is rounded, any of the above curved surfaces can be accurately measured in thousandths of an inch.

The black enameled frame is strongly ribbed, while thimble and sleeve have rust resistant, chrome finish against which markings are clear and easy to read under any illumination. Graduations are Quick Reading with every thousandth numbered for fast, error-proof reading. A complete table of decimal equivalents is conveniently stamped on the thimble. Spindle has one piece construction with threads hardened, stabilized and ground from the solid. **T-9-873**



Pneumatic Grinder

A small pneumatic die grinder designed for precision grinding on small dies, castings and hard-to-get-at spots is announced by the Mall Tool Co., 7725 So. Chicago Ave., Chicago 19, Ill. The entire tool is only 4⅝ in. long x 1¼ in. wide and weighs 12 ounces.



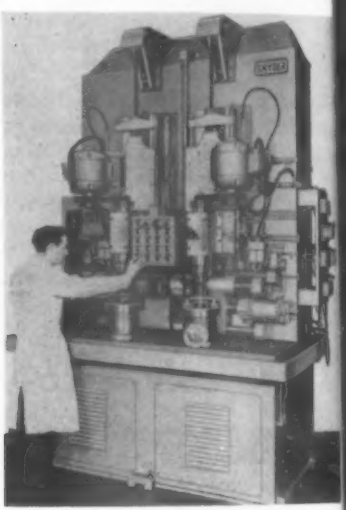
A choice of lever or button-type throttles, with a special collet guard, permits holding the tool close to the work. This permits finger-tip operation with good balance in tight areas. Arbor runout is said to be held within 0.0015 in. Available collets cover shank sizes from 1/64 to ¼ in.

The tool develops 26,000 rpm; however, speeds can be stabilized within a limited range by a built-in speed regulator. Air exhaust is directed away from the operator, to clean and cool the work, and the motor is equipped with a noise silencer that dampens high pitch tones. T-9-8

Duplex Machine

An automatic duplex machine designed to precision bore and face engine shields for fractional hp electric motors, by Snyder Tool & Engineering Co., 3400 E. Lafayette, Detroit 7, Mich., is said to combine high production and low unit cost with uniform accuracy of operation.

The operation consists of finish turning and facing the rabbet on the OD of the aluminum body and finish boring the I.D. of the hub bushing, which may be either steel or babbitt. Production rate is 210 to 338 pieces per hour at 75 percent efficiency, depending upon the size of the part, length of feed, and material being cut.



Power is supplied by two 1 hp, 600 rpm chuck motors and two ¾ hp 1800/900 rpm spindle motors. Spindles are driven through V-belts which allow variation in the spindle speeds. Prevailing spindle speed is 4778 rpm and chuck speed 334 rpm. Clamping is automatic by means of a spring diaphragm, while unclamping is accomplished by hydraulic return of the diaphragm.

The duplex cycle consists of unloading and reloading one station while the other works. Work cycle—using tungsten carbide tools—is rapid advance, feed, and rapid return cross slide to machine rabbet with chuck revolving, then feed and rapid return spindle to bore bushing with spindle revolving only. Feed rate of cross slide is 10 in. per minute while feed rate of spindle is 15.3 ipm. T-9-88

USE READER SERVICE CARD ON PAGE 101 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

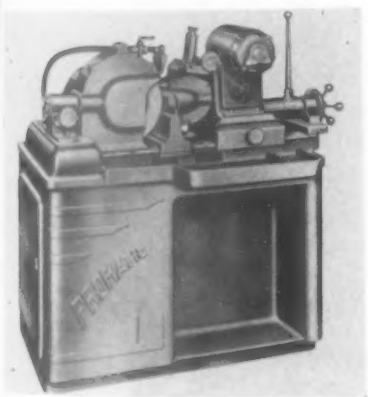
Shell Trimmer

The V & O Press Co., Div. of Emhart Mfg. Co., Hudson, N.Y., announces the No. 986 shell trimmer to its line of shell case trimming equipment. The machine has capacity for handling 155 mm shells, with a maximum length of 52 in., maximum diameter of 8¼ in., and thickness of 0.150 in.

The machine incorporates an automatic chute for feeding the shells, an air-operated mechanism for locating them in position for the trimming operation, and automatic ejection which delivers the finished shells to a conveyor. Complete details may be had from the manufacturer. **T-9-891**

Centerless Grinder

Diversified Metal Products Co. announces the Promatic No. 1 centerless grinding machine which—as tersely described—is "a smaller machine for average work". The machine is sturdily constructed and incorporates heavy-duty spindles mounted in pre-loaded anti-friction bearings. Maximum capacity is 1¼ in. stock diameter.



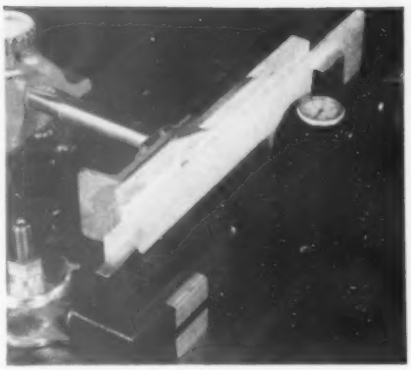
Main spindle speed is 1600 rpm; grinding wheel, 14 in. dia. x 4 in. face; regulating wheel, 7 in. dia. x 4 in. face; grinding wheel motor, 2 hp 1800 rpm; regulating wheel motor, ¼ hy Varidrive. Motors are stated as extra equipment. Complete details of this interesting tool may be had by writing the manufacturer, P.O. Box 362, Los Angeles 58, Calif. **T-9-892**

Gage for Knives

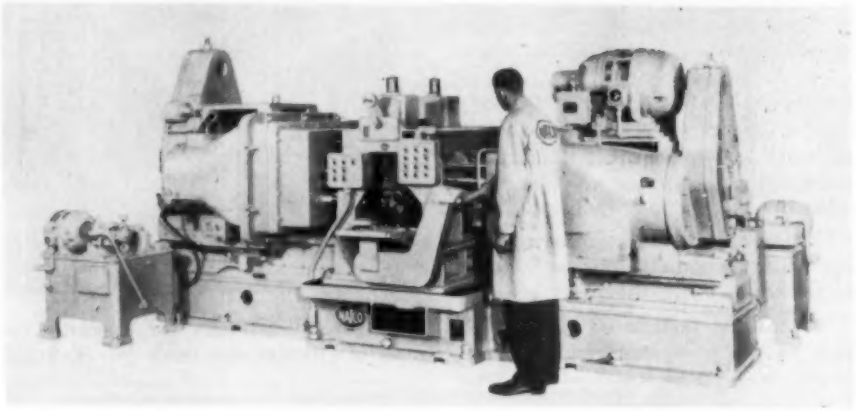
A practical gage for permitting quick accurate measurement and adjustment of planer, jointer, shaper and router knives is announced by PTI, Inc., 401 Broadway, New York. With this proper checking gage, setting knives of power tools are said to be made quickly and more accurately, thus providing considerable savings in man hours.

Precision built, and guaranteed, the gage is designed to measure in 0.001 in. on its two-faced dial.

An unusual feature is that the dial gage can be unmounted from the arm and used separately for checking the set of circular saw teeth. **T-9-893**



Two-Way Horizontal Holetapper



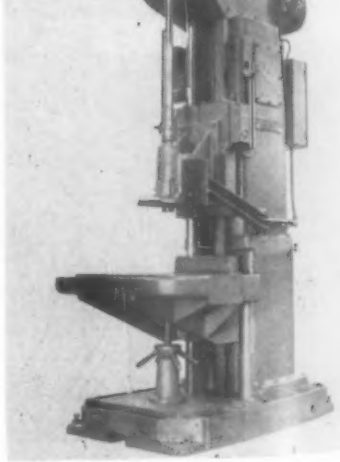
One of the many special machines being introduced during NATCO's 50th Anniversary Year celebration is a two-way horizontal Holetapper said to be capable of tapping 47 holes in 20 automotive cylinder blocks per hour.

All operations are automatic as follows: Left Hand Head: taps 11 holes to ¾ in. pipe tap; taps 4 holes to ⅛ in. pipe tap; taps 2 holes to 5/16 in. pipe tap; taps 5 holes to ⅜ in.-16 tap; taps 1 hole to ⅜ in. N.P.T. Right Hand Head: taps 13 holes to 7/16 in.-14 tap; taps 6 holes to ¾ in. pipe tap; taps 4 holes to ½ in.-13 tap; taps 1 hole to ⅛ in. pipe tap. Production is said to be approximately 20 parts per hour. National Automatic Tool Co., Richmond, Ind.

T-9-901

Vertical Drillmasters

The Standard Machine & Tool Co., Ltd., Windsor, Ontario, introduces four vertical hydraulic drilling machines which are now available to U. S. industry. These Drillmasters—as they are called— are designed in 3, 5, 10 and 15 hp models. The 3 hp machine has 12 in. stroke with drilling capacity of 1½ in. in steel at 0.010 feed per revolution. The 5 hp machine has 15 in. stroke with capacity 2½ in. at same feed increment. Capacities of the two larger machines are proportionate.



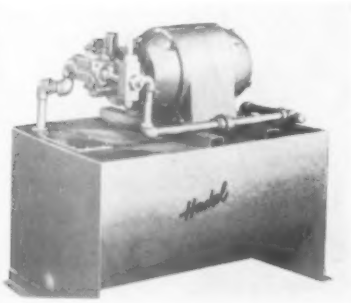
For actuation of the sliding head, these machines use the John S. Barnes hydraulic type 34 feed and traverse circuit. Feeds from ½ to 12 in. per minute are available, with dwell provided by setting of a valve. Step drilling and skip feed can be included. The hydraulic system conforms to J.I.C. Standards.

T-9-902

Hydraulic Power Units

A complete line of hydraulic power units containing 224 standard models, combining reservoir, pump and motor into a compact, practical unit is now in production by Haskel Engineering Works, 721 W. Broadway, Gendale 4, Calif.

Available for either stationary installation or for use as a portable unit with two swivel and two fixed heavy duty synthetic rubber tread casters and provisions for towing, the units are manufactured in three basic standard series: (1) Low-pressure units supply up to 1750 psi pressure and range from 1½ to 50 gpm in single pump models or to 100 gpm in double pump models. (2) Hi-Low units provide a dual pressure source by combining a high pressure and low pressure pump with automatic unloading of the low pressure pump. These units provide rapid movement of a ram or cylinder, or quick closure of the daylight opening stroke of a press, then automatically unload the high volume pump, still pumping a low volume at a high pressure for the work portion of the cylinder or press stroke. This automatic unloading feature is said to reduce the power requirement by one-half over a non-unloading system. (3) Hi-Pressure units supply up to 10,000 psi pressure and range from 1½ to 5 gpm in single pump models and to 10 gpm in double pump models.



Features of the Low-Pressure and Hi-Low units include visible oil level indicator plugs, adjustable pressure relief valves, piston or dial type gages, clean-out plates, two drain ports, proper sump capacity, proper oil filters, filtered-vented filler caps, and necessary baffling for anti-foaming and oil cooling.

The electric motors have bell ends for integral pump mountings for all motors from 1½ hp to 15 hp. Standard motors are 220/volt, 60 cycle, 3 phase.

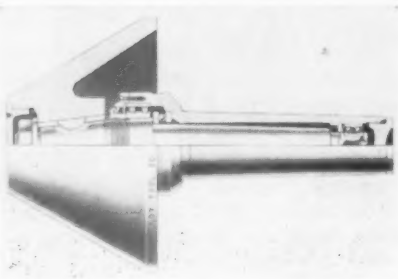
T-9-911

USE READER SERVICE CARD ON PAGE 101 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Multi-Purpose Center

Ready Tool Co., Bridgeport, Conn., offers a multi-use center with a bull nose, replaceable point center, so designed that the bull point can be removed quickly and another bull point inserted to accommodate the work—yet without requiring removal of the center on the machine.

A center of this type is considered more suited for heavier type of work on tubing or pieces with large center holes and performs at top efficiency on engine lathes, turret lathes or grinding machines. The center's roller bearing design assures accuracy providing maximum radial and thrust load capacities. The multi-purpose centers, known as RED-E-Superaccurate, are available in any required shank, taper or head size.



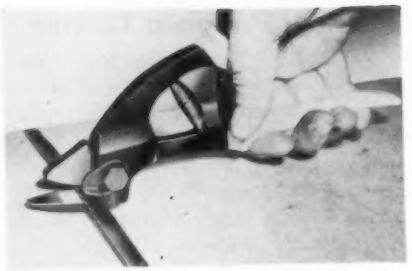
T-9-912

Strap Cutting Tool

Acme Steel Co. has just introduced the E14AO Strap Cutter, a light-weight tool designed to cut flat steel strapping up to ¾ x 0.035 in. with minimum effort.

Among features of the simple construction is a band guide which prevents straps from wedging sidewise between the blades. A flat lower blade permits easy insertion beneath tensioned straps on bales, bundles and cartons.

Frame and blade are constructed from forged steel for rugged performance. Narrow span handles are curved



to fit the grip of the operator. Measuring 9½ in. in length, the tool weighs one pound.

Further information may be obtained from the company, Department 30P, 2840 Archer Ave., Chicago. **T-9-921**

Spindle Nose

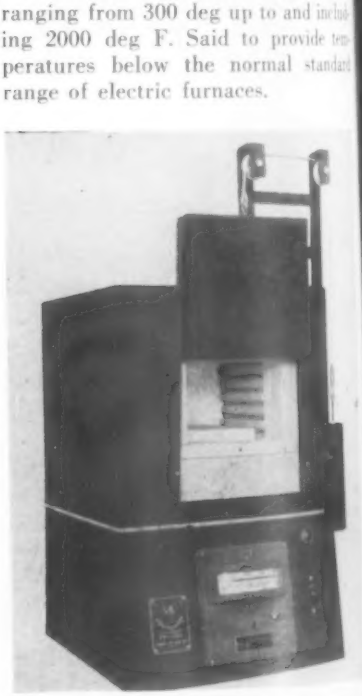
A Thread-Lock Spindle Nose has been announced by the Wade Tool Co., Waltham, Mass., as a feature of the No. 8A Toolmaker's Precision Lathe.

The particular advantage claimed for the tool is that the chuck is located and locked with one simple half turn of a locking ring, thus lessening the chance of leaving something undone, such as failure to turn a screw or cam.

The Thread-Lock Spindle Nose secures chucks, faceplates, and other accessories to the spindle with accuracy, is rigid and completely safe. For precision location, the American Standard Taper D1-3 in. is employed in conjunction with the Wade Thread-Lock principle. T-9-922

Combination Furnace

The Huppert No. 869 combination hardening and tempering furnace, with electronic controller, is designed to provide automatic control of temperatures ranging from 300 deg up to and including 2000 deg F. Said to provide temperatures below the normal standard range of electric furnaces.



The furnace is 8 x 6 x 9 in. deep, with maximum current consumption stated as 4 K.W. It is wired for 220 V. single phase operation. An easy-to-operate counterweighted door rides in a wedge slide to provide a tight seal in closed position. Descriptive literature may be had from the K. H. Huppert Co., 6826-32 Cottage Grove Ave., Chicago 37, Ill. **T-9-923**

Heavy-Duty Grinder

Designed for grinding of extra-large work such as big gun mounts and large components of oil machinery, steel mill equipment, and other industrial equipment, the 2200 Series Frauenthal grinders have a swing range up to 150 in. diameter. Despite its size, the manufacturer claims parellelism tolerances of 0.0002 to 0.0003 in., with angular accuracy less than 0.0005 in. in 72 in.

As features of design, the table, spindle, and main spindle housing are assembled into a rigid, integral unit. The table is a heavy-semi steel casting, provided with radial T-slots for work clamping and ribbed and assembled to prevent distortion or tilting under uneven loading.

In addition to precision grinding, the machine can be adopted to precision boring and facing. A rugged tool-holder bracket is available, as an accessory, for mounting on the vertical slide in place of the grinder head. **T-9-931**

Hydraulic Drill Unit

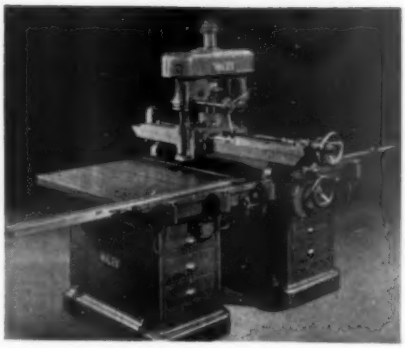
Delta Power Tool Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1, Wis., announces the No. 19-400 air-powered hydraulic drill unit. Designed for heavy-duty, high-production work on drilling, tapping, spotfacing and similar operations, the unit will take drills up to ⅝ in. in steel. Because of the sealed construction, it may be mounted in any position.

The spindle is driven by electric motors ranging from ¾ to 1½ hp, either directly through a gear train or by V-belts. Plant air supply provides thrust. Feed is infinitely variable from zero to 50 ipm, full stroke 4 in., and spindle returns in one second. The unit may be equipped to feed on the back stroke for threading and back spotfacing. **T-9-932**

Versatile Drill

Close dimensional accuracy is assured by a precision-built drill head in combination with a guide support which, vertically adjustable, positions the drill bushings close to the work. An extra-large bearing area on the drill head assembly base further provides accurate travel at 90 deg on two ground ways across a solid bridge.

Designed for precision layout, drilltion and capacity to take work of prac-Wales-Strippit features ease of operaing and reaming, a drilling machine by tically any length and up to 36 in. in width.



A large table provides complete support of the work. Table ways are hand scraped for increased accuracy, and table movement is facilitated by ball roller inserts. Work is clamped to a long slide rail which moves it left or right under the drill head; thus, rigidity is provided that adapts the machine to certain types of jig boring. Full information on this interesting tool may be had from the Wales-Strippit Corp., 345 Payne Ave., No. Tonawanda, N.Y.

T-9-941

Heavy Duty End Mills

Heavy duty end mills with 2 in. diameter shanks and fast-cutting helix have recently been added to the line of Pratt & Whitney "Hi-Helix" End Mills.

These cutters are of rugged design and have ample chip clearance for taking heavy end milling cuts. They also are said to be well suited for Kellering, die sinking and similar work. Shanks are of the Weldon type and have two

set screw flats for positive drive.

The cutters range in diameter from 2 to 2½ in., and in length of cut from 4 to 6 in. They are made of high-speed steel with right hand cut and right hand spiral flutes. Detailed listings are included in the new Pratt & Whitney booklet, "End Mills for All Purposes", available from the company.

T-9-942

Metal Working Lubricant

Lubricants, Inc., 908 Fisher Bldg., Detroit 2, Mich., has brought out a cutting lubricant designated "Tuff-Kut," based on a new theory in cutting tool lubrication. The transparent and practically colorless water solution serves as an effective lubricant and is claimed to increase production and prolong the life of tools by its improved cooling and lubricating properties.

According to the manufacturer, its rapid heat-dissipating properties permit the use of higher cutting speeds, while low viscosity permits it to reach the point where its lubricating and cooling properties are most effective. The correct solution for the individual job is obtained by adding the required amount of water to the concentrated "Tuff-Kut." The lubricant does not smoke during the cutting operation, can be easily removed from chips, and has no unpleasant odors.

Tuff-Kut compound also may be used for drawing and forming metal and may be painted over without washing the compound off the metal parts.

T-9-943

High-Capacity Switch

Micro Switch, a division of Minneapolis-Honeywell Regulator Co., is now offering rigid lever-actuated high capacity basic switches in a "V" series, broadening the line of their "Type A" basic switches.

The addition of rigid lever actuation, has been brought about by requests for a high capacity basic switch requiring a lower operating force than that offered by their flexible leaf actuated switches.

These switches are listed by Underwriters' Laboratories for ¾ hp 115 volts, a-c; 1½ hp 230 volts, a-c; 20 amperes 125, 250, or 460 volts, a-c; 10 amperes 125 volts, a-c "L" ("L" suitable for controlling tungsten filament lamp loads on a-c circuits).

The rigid lever actuators are located in the same positions as those of other "Type A" basic switches and there is a choice of a long straight lever, a short lever with a roller and a long lever with a roller.

This "V" series of "Type A" precision snap-action switches has a 0.020 in. contact separation (contact break distance) and contact arrangement is single-pole, double-throw. Three types of terminals available include solder lugs, integral screw terminals and side facing binder head screw terminals.

The operating characteristics of these new high capacity switches are covered in a revised Data Sheet covering the entire Micro line of "Type A" basic switches available from the company.

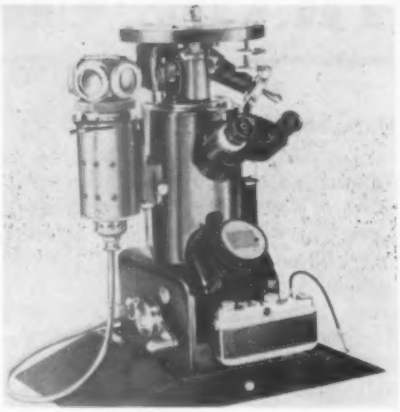
T-9-951

Optical Metallograph

Designed for fast and accurate structural anaylsis of metal samples and other substances, the OPL Metallograph is said to provide all necessary facilities for examination, study and photographic reproduction needed for research and routine testing. Ocular and projective lenses are parfocal and parcentered, mated on all air-glass surfaces and corrected for infinity. The entire unit measures 12 x 12 x 18 in. high.

The user can observe the sample through binoculars or on a ground glass screen, and photographs may be taken on 35 mm roll film by swinging the image from the ground glass to the camera. Controls are further provided for fast and positive manipulation of all variables; also, lenses may be changed without need of refocusing. Complete information available from F. T. Griswold Mfg. Co., Wayne, Pa.

T-9-952



TRADE LITERATURE

Free Booklets and Catalogs Currently Offered By Manufacturers

Data Sheets

Eighty-page book contains tabulated information on 180 different compositions of vanadium irons and steels, spring, plate and sheet, tool, cast steels and alloyed irons; chemical compositions, heat treatments, mechanical properties and typical uses also covered. Request on company letterhead. **Vanadium Corp. of America,** Graybar Bldg., 420 Lexington Ave., New York 17. **L-9-1**

Barrel Finishing

Illustrated 12-page booklet "3M Barrel Finishing" explains what barrel finishing is, who can use it, and what specific advantages it offers; gives applications for compounds developed for this process; discusses methods for deburring, surface finishing and precision finishing. **Minnesota Mining and Mfg. Co.,** 900 Fauquier St., St. Paul 6, Minn. **L-9-2**

Air Tools

Catalog 38 illustrates and describes line of air grinders, drills, hammers, scalers; engineering drawings show assembly and special features; specifications and data pertinent to applications included. **The Rotor Tool Co.,** 17325 Euclid Ave., Cleveland 12. L-9-

Bending

First issue of "Pines Engineering News", bi-monthly bulletin for the metalworking field; features bending and end-finishing techniques, tooling data on outstanding jobs, details on recent developments and applications, as well as helpful facts on short-cut production methods. **Pines Engineering Co., Inc.,** 601 Walnut St., Aurora, Ill. L-9-

Grinders and Arbors

Specifications, dimensional diagrams and application suggestions for using saw and adapter arbors to build wide variety of special production tools included in 8-page illustrated catalog. **Poly Products,** 2032 E. Walnut St., Pasadena 8, Calif. L-9-

Pyrometer Accessories

Bulletin P1238, combination catalog and handbook, gives information helpful to those interested in thermocouples and pyrometer supplies; discusses design and engineering data on factors affecting life, corrosion and poisoning, installation. **The Bristol Co.,** Waterbury 20, Conn. L-9-

Switches

Condensed Bulletin No. 54 acquaints consumer with scope of line; is divided into sections, each dealing with particular group of switches, describing and illustrating representatives in each classification, pointing out diversification of line. **Micro Switch,** Freeport, Ill. L-9-

Solder

Widely illustrated 36-page educational brochure on the nature, properties and uses of solder; deals with selection, applications and types; tables cover melting range, A.S.T.M., SAE, Federal and National Military Establishment specifications. **Federated Metals Div., American Smelting and Refining Co.,** 120 Broadway, New York. L-9-

USE READER SERVICE CARD ON PAGE 101 TO REQUEST ADDITIONAL TRADE LITERATURE INFORMATION

Good Reading

A GUIDE TO SIGNIFICANT BOOKS AND PAMPHLETS OF INTEREST TO TOOL ENGINEERS

DESIGN OF MACHINE MEMBERS, by Alex. Vallance and Venton Levy Doughtie. Published by the McGraw-Hill Book Co., New York, N.Y. 500 pp.; price $6.00.

This is a third edition which, like its predecessors, offers a balance between theory and practice. All chapters have been revised—in some instances rewritten entirely—in order to bring material completely up-to-date. Changes in this edition include:

Wherever possible, consistent and standard notation throughout the text; additional material dealing with stresses, riveted joints, threaded fasteners, gears, and hoisting and power chains; also, expanded presentation and more logical treatment of endurance limit, eccentric loading, columns, structural riveting, and so on. Taken as a whole, the book presents problems designed to give the student practice in applying principles discussed and to stimulate constructive thinking.

ENGINEERING MATERIALS MANUAL, edited by T. C. DuMond, Editor of *Materials and Methods*. Published by Reinhold Publishing Corp., New York, N.Y. 386 pp.; price $4.50.

This work consists of the collected manuals on engineering materials that have previously appeared in the series on "Materials and Methods Manuals" that have been published in *Materials and Methods* during the past several years. Each of the 28 sections present a complete story on a single material or group of materials, all in addition to important engineering information of especial interest to engineers and others concerned with materials.

PROCEEDINGS of 14th Annual Time and Motion Study and Management Clinic, sponsored by the Industrial Management Society, November 1-3, 1950, at the Sheraton Hotel, Chicago. Price $3.00.

The 112 pages include charts, forms and illustrations, and a complete transcript of talks by top leaders of labor, management and government on various topics. The whole covers various topics including time study, motion economy, methods, plant layout, materials handling, wage incentives, maintenance and human relations. Available from the Industrial Management Society, publishers, 35 E. Wacker Drive, Chicago 1, Ill.

Abstracts of Foreign Technical Literature

By M. Kronenberg

Great Britain: There has been a marked increase, during the past decade, in the use of pneumatic gages in precision engineering, in workshops as well as in inspection rooms. This technique, as indicated in an article by Graneek and J. C. Evans in the British edition of *Machinery* of July 5, has special advantages for measurement of fine bores and similar applications and has the merit of combining in one instrument high sensitivity with simplicity of operation.

However, the increase in sensitivity has been attained at the expense of speed of response. The sluggishness is often a drawback, particularly when it is required to measure fairly rapidly changing dimensions. The National Physical Laboratory, England—which corresponds to the National Bureau of Standards—has developed a new comparator combining high-speed of response and high sensitivity as described in the article, covering theoretical considerations, calibration, forces, and application. The dial gage is so graduated that one division corresponds to one millionth of an inch.

Operations and equipment for machining of barrels of 20 pound tank guns are described in the issue of June 2 of the British edition of *Machinery*, including forging at the Royal Ordnance Factory at Nottingham, piercing, rough turning and heat treatment. While high speed steel tools are used for the rough turning operation at 21 rpm and a feed of 1/8 in. the piercing operation (trepanning in American terminology) is performed on a gun boring machine with carbide tipped tools at 600 rpm. at a rate of 3 in. per minute. The floor to floor time for the 21 ft barrel is now 2½ hours as against 12 hours previously.

This reduction was obtained by redesigning the lathes with new headstocks and the incorporation of a high pressure coolant system, delivering 50 gallons per min at 300 lbs in.^{2} pressure. The workhead is driven by a 100 hp motor, and the coolant system by a 3 hp motor. The boring time was reduced 9½ hours, in addition to gain

5½ hours by elimination of a honing operation. This was possible because the new boring method proved to be highly accurate.

The development in "Hot Brass Pressing" is discussed in the British edition of *Machinery* of June 21. Although the process has been known for about thirty years, the most significant progress has been made in the past few years. Hot brass pressing belongs in the same category of manufacturing methods as powder metallurgy and die casting insofar as the elimination of subsequent machining operations is concerned. The process is virtually one of forging, insuring a homogenous structure free from porosity and permitting accurate production of fine details at high surface finish. Equipment required for the process, as well as die design, die materials, die cutting and the heating for pressing, are discussed in detail.

Switzerland: Important investigations have been carried out at Zurich University exploring a field which has received only little attention in workshops all the world over, namely the increasing effect of noise on the human ear and the loss of hearing. These tests are described by J. Zwislocki in the magazine *Industrielle Organisation* No. 2, indicating that the least reduction in hearing was found in a textile mill, a greater one in a factory producing zippers, while employees in a noisy department of a candy plant experienced a substantial loss in hearing. The worst conditions existed in the riveting department of a boiler plant. Improvements were obtained by using ear protectors made of plastic material, whereby some American made devices also were tested. The article is illustrated by numerous diagrams, showing the reduction in hearing under various conditions and the recovery in cases where the ears were protected against noise. Such recovery usually reduced also time losses due to headaches etc.

"Quality and Cost" was the topic of a paper presented by O. Zollikofer in French language before the International Congress of Machine Manufacturers at Brussels, as published in *Industrielle Organisation* No. 1. Referring to the *Tool Engineers Handbook* the author points out that only very few books like this one are on the market with information on the relationship between quality and cost of production. For this reason time studies were made in a large Swiss plant whereby it was found that—as an example—the time required for measuring workpieces increased very considerably as the accu-

(Continued on page 100)

Abstracts of Foreign Technical Literature

(Continued from page 99)

racy increased, and that tolerances less than 0.002 in. cause substantial crease in cost. He calls this the "thr old of economic production" and ommends that such investigations extended into other fields of engin ing.

"The tool engineer must not be isfied only with high productive chine tools, free of vibrations and high accuracy, but must adapt his sign to the requirements of eas operation to a considerably greater tent than before." This postulate discussed by E. Bickel in an article *Industrielle Organisation*, No. 5, 19

It will often be possible for the t designer to follow this rule without outside aid but there are also ca where the assistance of a physician psychologist is indicated, such as in case of providing and designing se for the machine operator in order to duce the physical strain and impr the efficiency of operation. Other s gestions for "adapting the machine the man" refer to improvements in tical measuring instruments on grind machines which are still often diffic to read; the reduction in noise caus by the feeder tubes on automatic scr machines is discussed among ma other items covering preselector he stocks, lever arm ratios, efficiency changing spindle speeds, etc. The a thor also discusses examples where his opinion, certain types of machi tools are "overdesigned" causing su stantial cost increase without a su stantial benefit in the operation of t machines.

Germany: It has always been difficult proposition to measure t roughness of the tool face and the c ting edge. Optical instruments oft used for such purposes are seldom sa isfactory because of the limited mag fication and the reduction in field observation. In an article, published b A. Heiss in *Werkstattstechnik* an *Maschinenbau* of June, theory and ap plication of an instrument are discusse where a sapphire edge is used f tracing along the surface of the tool an permitting magnifications up to 10 diameters. The sapphire is ground to keen edge of about 0.010 in. width an placed at 90 deg to the surface to b measured. Milling cutters, lathe tools reamers, broaching tools and othe cutting tools have been investigated i this way whereby profiles can be checked in conjunction with the Forste surface measuring instrument.

THE TOOL ENGINEER'S *Service Bureau*

TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

LITERATURE NUMBER	COMPANY	BULLETIN	DESCRIPTION
-138	ALLEGHENY LUDLUM STEEL CORP.		"Hot-Work Steels" tells about the chromium, molybdenum, vanadium hot die steel known as Potomac M.
-117	AMERICAN BROACK & MACHINE CO.	100	Discusses American 3-way broaching machine adaptable to push, pull or surface broaching.
-122	ALLOY RODS CO.	2519	Shows grade selection and "how to do it" information; describes tool-arc electrode grades to match tool and die steels.
-24	F. E. ANDERSON OIL CO.		Twenty-page "Lusol—the all-chemical Metalworking Solution".
-92	E. A. BAUMBACH MFG. CO.	B-50	Contains information concerning die sets.
-111	THE BELLOWS CO.	CL-30	Bulletin covers line of controlled air cylinder motors.
-152	BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE CO.		Informative booklet on cost-cutting, production-speeding possibilities of Robotair units.
-141	BETHLEHEM STEEL CO.	271	Booklet designed to help in selection of right tool steel for specific purpose.
-11	BEHR-MANNING CORP.		"Proving Ground for Production" covers details of service concerning company's Methods Rooms for trying out grinding and polishing methods.
-145	BROWN & SHARPE MFG. CO.		Details of Universal Milling Machine line and its production-boosting features in company bulletin.
-159	CHICAGO WHEEL & MFG. CO.		Literature and engineering report concerns firm's "XL" bond silicon carbide grinding wheels.
-26	THE CINCINNATI SHAPER CO.	S-5	Catalog covers complete line of Cincinnati all-steel shears.
-134-1	THE CLEVELAND TAPPING MACHINE CO.	T-7	Maximum production with minimum labor costs is theme of catalog.
-151	THE CUSHMAN CHUCK CO.	PO-8	Bulletin discusses special features and advantages of company's iron body air cylinders.
-153	THE DOALL CO.		Twenty-page bulletin describes DoAll gage blocks and accessories.
-161	THE DOALL CO.		Catalog discusses jobs that company's band machining can do.
-156-1	THE EASTERN MACHINE SCREW CORP.		Various catalogs describe "Selecting Proper Die Head for the Job", Style MM, Style DMS, Style DM, and Style TM machines for cutting screw threads.
-169	EX-CELL-O CORP.	35371	Bushing catalog describes company's line.
-88	THE J. C. GLENZER CO., INC.		"Index File B" contains complete data on adjustable adapters for multiple spindles.
-162	GRAYMILLS CORP.		Catalog contains information on Agitor parts cleaning systems.
-150-4	GROBET FILE CO. OF AMERICA, INC.	HC1	Catalog sheet discusses company's chatterless counter-sinks.
-126	HANNIFIN CORP.	110	Bulletin covers Hannifin hydraulic cylinders.
-3	HARDINGE BROTHERS, INC.	36	Complete descriptions, specifications and ordering information.
-115	HAYNES STELLITE CO.		"Operating Information" gives recommended cutting angles, speeds and feeds and grinding wheels for Haynes Stellite 98M2 tools.
-87	HOWE & FANT, INC.		Literature covers company's Lign-o-matic turret.
-143	ILLINOIS TOOL WORKS		Detailed information on reducing gear cutting tool costs with Certified unground hobs.
-13	JONES & LAMSON MACHINE CO.		Catalogs describe line of tangent dies up to 2 in. dia. capacity, and radial dies up to 4¼ in. dia.
-95	KEMPSMITH MACHINE CO.		Bulletin describes Kempsmith standard attachments.
-105	KENNEMETAL INC.		Automatic calculator included among several service aids offered to industry.

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A-9-92	KLINGELHOFER MACHINE TOOL CO.		Full information on specifications and illustrations on [illegible] line of drilling machines.
A-9-3	LANDIS MACHINE CO.	F-80, F-90	Bulletins contain detailed information and specifications [illegible] threading machinery.
A-9-21	THE LAPOINTE MACHINE TOOL CO.	HP-5	Illustrated technical bulletin on broaching machines.
A-9-28	LATROBE ELECTRIC STEEL CO.		Eighty-six page tool and die steel manual.
A-9-116	METAL CARBIDES CORP.	50-C	Specifications, engineering and ordering information [illegible] tained in Talide Tool Catalog.
A-9-123	MILLER MOTOR CO.	B-200	Full details on Miller fluid pressure boosters.
A-9-90	MOORE SPECIAL TOOL CO.		Twenty-four page catalog contains examples of time [illegible] cost-cutting jib borer operations.
A-9-137	MICROMATIC HONE CORP.		"Cross-Hatch" describes the Microhoning process.
A-9-97	MORTON MACHINE WORKS.		Complete line of fixture clamps and components plus [illegible] size templates for tracing contained in 72-page catalog.
A-9-160-1	OAKITE PRODUCTS, INC.		"Some good things to know about Metal Cleaning".
A-9-108	PHYSICISTS RESEARCH CO.		Bulletin explains how company's Profilometer can help [illegible] costs.
A-9-106	PIVOT PUNCH AND DIE CORP.		Catalog stresses advantages of Pivot Punch service.
A-9-8	POPE MACHINERY CORP.	58A	Catalog deals with Pope's heavy duty motorized spindles.
A-9-107	POTTER & JOHNSON CO.		Booklet discusses examples of productivity with P & J tooling on P & J Automatics.
A-9-129	A. SCHRADER'S SON		Information on Schrader air line fittings and blow guns.
A-9-121	SCULLY-JONES AND CO.	8-50	Bulletin shows complete range of sizes, sepcifications [illegible] "JA" floating holders.
A-9-83	THE SENTRY CO.	C	Presents story of company's heat treating and hardening [illegible] methods.
A-9-100	SIMONDS ABRASIVE CO.		Data book concerning Simonds grinding wheels.
A-9-134-3	SOUTH BEND LATHE WORKS	67-F	Catalog discusses company's 2-H turret lathe stressing [illegible] speed and precision.
A-9-5	STANDARD GAGE CO., INC.	B	Catalog covers firm's line of gages.
A-9-19	THE L. S. STARRETT CO.		Starrett dial indicator catalog, transfer chart, and physical [illegible] dimension chart offered as three useful aids to those concerned with production inspection.
A-9-164-3	P. A. STURTEVANT CO.		"Sturtevant Torque Manual" presents data useful to design [illegible] and production men.
A-9-15	SUNDSTRAND MACHINE TOOL CO.	711	Bulletin presents complete line of Sunstrand automatic [illegible] lathes.
A-9-76	THE HENRY G. THOMPSON & SON CO.	HS-1951	Hack saw bulletin covers Milford saw line.
A-9-164-4	TUTHILL PUMP CO.	Model L	Bulletin presents information on pumps for pressure lubrication, hydraulic controls, liquid transfer.
A-9-125	VANADIUM ALLOYS STEEL CO.		"Die Steels for Cold Work"—detailed metallurgical brochure.
A-9-150-1	THE VAN KEUREN CO.		Catalog and handbook contains 206 pages of data representing two years of research on measuring and gaging.
A-9-170	WALES-STRIPPIT CORP.		Fully illustrated catalogs tell story of Wales hole punching and notching equipment, stressing time and money savings.
A-9-80	WENDT-SONIS CO.		Carbide equivalent chart shows carbide manufacturers' grade recommendations.
A-9-132	THE YODER CO.		Seventy-eight page book discusses economics as well as mechanics of doing your own slitting.

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North East West South IN INDUSTRY

Herbert B. Link, executive vice-sident since 1939 of **The Bellows** ., has been named president of the mpany succeeding the late L. F. R. llows. At the same time **L. F. R. llows, Jr.**, was named vice-president, **Byron D. Kuth** was made secre-y-treasurer. The same officers were ewise named for The Bellows Electric n Corp., and Bellows Products, Inc., iliated companies.

The board of directors of **The E. orton & Son Co.** recently announced e election of R. S. Cooper as president the company. Mr. Cooper, one of the -founders of The Gabb Mfg. Co., Inc., ame vice-president of Horton & Son charge of The Gabb Special Products iv. in July, 1949, when the companies erged.

Robert D. Turner has been ap-ointed secretary-treasurer of the **Mar-el-Schebler Products Div.** of **Borg-Warner Corp.** Mr. Turner, who suc-eeds Walter E. Walpole, resigned, has en assistant to the treasurer of the rm's Pesco Products Div. at Bedford, hio.

Ressler A. Dusseau has been ap-ointed assistant general manager of e **Automatic Transportation Co.** Mr. Dusseau, who joined the organiza-ion in 1949, has been chief engineer f rider-type electric trucks. He now ssumes responsibilities formerly held y Theodore Smith, who has resigned.

The board of directors of **The Car-enter Steel Co.** recently announced he appointment of **George V. Luers-en**, formerly chief metallurgist, to the ost of vice-president in charge of metallurgy. Mr. Luerssen succeeds **B. H. DeLong**, who announced his re-irement as vice-president and technical director after 41 years of continuous ervice with the company.

Arthur J. Williamson has been ap-ointed vice-president in charge of man-ufacturing operations by **Tube Reduc-ing Corp.** according to recent an-nouncement. Mr. Williamson has an outstanding reputation in the tubing business through his work on tubular committees of the American Society for Testing Materials, American Society for Metals, American Iron and Steel Insti-tute, British Iron and Steel Institute, Society of Automotive Engineers and the Institute of Aeronautical Sciences.

During recent election at **Darwin & Milner, Inc., James D. White, Jr.**, was named vice-president and general man-ager. Mr. White formerly was assistant general manager.

William W. Wellborn has been ap-pointed research engineer of the Car-bide Research & Development Dept. of the **Firth Sterling Steel & Carbide Corp.** Mr. Wellborn was previously associated with the Los Alamos, AEC, Scientific Laboratories of the University of California, where he designed and equipped the present powder metallur-gical laboratories.

Election of **Warden F. Wilson** as president of the **Alloy Casting Insti-tute** has been announced by E. A. Schoefer, executive secretary of the or-ganization. Mr. Wilson is general sales manager, Lebanon Steel Foundry.

J. L. Singleton, vice-president in charge of the general machinery divi-sion, and **R. S. Stevenson**, vice-presi-dent in charge of the tractor division, were recently elected to the board of directors of the **Allis-Chalmers Man-ufacturing Co.**, succeeding the late Walter Geist and W. C. Johnson.

At the same meeting, **W. E. Hawkin-son**, secretary and treasurer of the com-pany was named a vice-president, sec-retary and treasurer.

Coming Meetings

Oct. 12-14, Annual meeting, **Metal Treating Institute;** Detroit.

Oct. 14-19, First World Metallurgical Congress, sponsored by **American So-ciety for Metals;** Detroit.

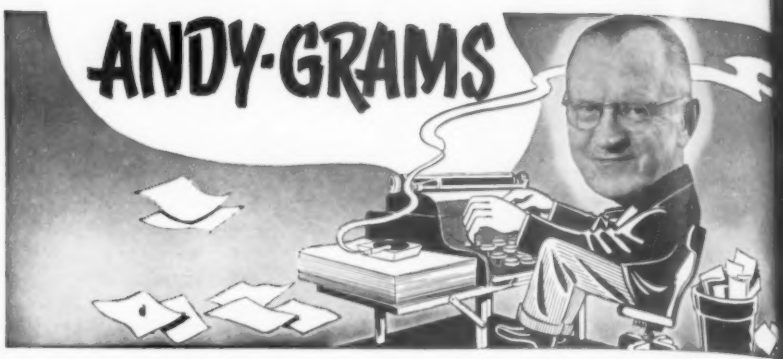
Oct. 15-19, 33rd annual Metal Show, to be held in conjunction with the Metallurgical Congress; Detroit.

Nov. 1-2, Fifteenth annual Time and Motion Study and Management Clinic sponsored by the **Industrial Manage-ment Society;** Sheraton Hotel, Chicago.

Nov. 19-20, 52nd annual convention-al, **National Metal Trades Assn.;** Palmer House, Chicago.

Sept. 26-28, fall meeting, **American Society of Mechanical Engineers;** Ho-tel, Radisson, Minneapolis, Minn.

ANDY-GRAMS



Winding up and about ready to pull out for the Coast as at date of writing, I'll give a brief resume of events of the past few weeks—weeks that, as far as I am concerned, have been replete with surprises. There's also been plenty of work, especially with regard to moving, so that when the last parcel went out the door the wife and I were about ready to drop from sheer fatigue. Even the dog was pooped out.

Y'know, it took a wrench of heart to turn the key in the lock for the last time. I designed the house and had supervised every detail of construction from foundation to chimney cap, and so could turn it over to the new owner with the satisfaction that he had full value for money invested. Incidentally, his name is Otto Boehm, an engineer with Ford Motor Company whom I hope to bring into the ASTE fold. You'll like him.

Thursday, July 26, the local ASTEers ran a party for me at the Wayne Club, and was that a gathering of the clan! Present were Les Bellamy and Monta Cox—who, as I got it, made up the sponsoring team—and Doug Anderson, incumbent chairman of Detroit chapter, along with about all of the past chairmen running back to genesis of No. 1.

These included Floyd Eaton, Lee Diamond, Clyde Hause, George Whitehouse, Clyde Mooney, Wayne Kay, Slim McClellan, Andy Carnegie, Charley Smilley, and Grant Wilcox, who acted as toastmaster. Also present were past-Presidents Walter Wagner and Al Sargent, with Bill Smila and Bert Carpenter corporally absent but present in spirit, the same going for Rudy Andreasson. A greeting from Prex Jake Demuth, who was busy fighting the floods down in St. Louis.

Among other attendees were Jimmy Giern, come all the way from Romeo; Harry Conrad; Ray Putnam; Gil Muir; Bill Fors; John Markstrum; Henning Freden; Ken Spalding; Jay Bowen; and Athel Denham, whose silent (?) partner had generously cancelled a birthday party so that her spouse could attend. And Elsa, thanks for your very friendly message.

Of course, I'd had previous intim tion of the party—they had to get m down there, y'know—but somehow I g flustered and suffered a mental block that I had to grope for names of ev my oldest friends. Can't be hardenin of the cerebral arteries a/c I'd just ha a physical check-up and declared fit a fiddle.

Everybody present had somethi nice to say about me, but when it ca my turn to respond I was still flustere and so didn't think of the nice things should have said until next day, ev forgot to thank the boys for the wonde ful gift—a beautiful 2-suiter. (Now I have to get me another suit, and I'v only had this one nine years.) How ever, I'm sure that the boys know how felt and so will overlook the lapse.

Among plaudits which may or may not have been deserved, I also came in for some good-natured ribbing a/c my column has carried considerable men tion of Swedes. I bring this up apropos what follows although, as for that there won't be much more in that ve a/c the Andygrams will conclude with the November issue.

What my friendly kibitzers overlooked is that about 20 percent of our membership has had less than 5 percent mention and that I've mentioned Hin doos, Canadians, Scots, Englishmen Aussies and Latin Americans among others whenever I've had news of them all with intent of fostering a closer unity among our members as well as ex panding the Society. On that score, my mail seems to attest to a job well done. At that, I'm reminded about the story of the bystander at a poker party who, seeing the dealer slip himself four aces, tipped off one of the other players. Said the latter: "So what, it's his deal, ain't it?" Anyway, I've made the tool engineers conscious of smorgasbord.

To continue, the evening of July 31 the Swedish Engineers Society of Detroit—the membership of which, incidentally, contributes materially to the ASTE—threw a party for me at The Stockholm. There too, I came in for more than my share of plaudits and was also presented with a combination

case—overnight bag, so now I'll to get another night shirt as well. 'n' bye I'll be America's best ed man.

riously, though, I am deeply ap- iative of the remembrances, espe- y to the Ladies Auxiliary of the for the beautiful remembrance to wife. As for myself, I realize that made friends both in the ASTE and where, but it took these send-offs, the good wishes, to make me fully reciative of the warmth of feeling ich was so manifestly expressed. To all concerned, thanks. I will not forget.

Wednesday, August 1, I attended a ss preview of Michigan Tool Com- y's latest opus—a revolutionary gear bber that turns out helical gears ter'n a cat can do you-know-what. An old gear man myself (dating back to 1894 with Brown & Sharpe) I can take pleasure in saying that Michigan Tool has done an outstanding job. It's some machine!

So you'll say I've talked about Swedes! Between Paul Zerkle, veep Joe Draper (charter member of the ASTE whom we're inviting back into the fold) and Don Moncrieff of Michigan Tool, and Bill Pennington of *Tooling and Production*, table mates at a luncheon at the Recess Club, I heard enough stories about Swedes to outdo the best of Sir Harry Lauder's tales about the canny Scots. And that was only a sample of what I get wherever I go. Talk about the pot calling the kettle black!

Anyway, I had a swell time passing the time o' day with prex Oscar Bard, veep Marvin Anderson, Harry Pelfrey and other Michigan Toolers, then, at the last minute, Sven Hellstrom of Detroit Tap & Tool came in to wish me happy landings in California. Old friends wear well.

Well, I can't offer much in the way of reciprocal hospitality or courtesies until I'm settled in a new home—which, I hope, won't take too long. For the time being, I'll be staying with my daughter at 2992 Vessing Rd., Walnut Creek, California, and if any of you boys are out that way drop me a line and we'll arrange to get together.

There's so much more I would have liked to have said, but I'm getting down to the period and so will see you next month in what I hope will be an interesting travelogue. But for now,

Au revoir,

Andy

Technical Shorts . .

A DISCOVERY originating in Carpenter Steel Company's laboratories is hailed as a possible solution to hot working problems. It was found that the proper application of misch metal transforms certain "difficult-to-work" high-alloy, corrosion resistant, heat resisting steels into products that can be forged and rolled into desirable shapes. According to metallurgists, the invention should enable the steel industry to produce greater quantities of hot workable alloys for many applications.

The "core" of the development involves the proper application of a rare-earth element called cerium—an element heretofore used extensively in flints to produce the spark in ordinary cigarette lighters. Obtained from pla... such as Florida, Idaho, India and Bra... it is of steely gray appearance, and ha... long been used as a basic metal i... pyrophoric alloys. According to t... researchers, cerium by itself or in co... binations with lanthanum, both fou... in misch metal, shows possibilities ... increasing mill yields from ingot to b... rolled bars, plates, tubes, and forgi... of corrosion and heat resistant steel... The new range of cerium bearing allo... promotes greater hot ductility and r... duces rejects. Theoretically forgers g... the benefits of better hot working, few... cracks and tears, as well as better fi... ishes requiring less machine clear-u... This brings up the possibility that fab... ricators may ultimately find a greate... supply of strategic steels because o... higher mill yields.

At least seven years in the develo... ment stage, the invention is said to ap... ply to ferrous alloys containing nicke... and one or more of the elements chr... mium, molybdenum, cobalt, copper... tungsten, silicon, manganese, columbi... um and vanadium. Heretofore, a prin... cipal obstacle to the full utilization o... the advantages offered by these allo... has been the difficulty or practical im... possibility of forging and rolling the... into desirable shapes like sheet, rod... and tubes. This has restricted their... uses in certain applications involvin... high temperatures, stresses and pres... sures. With the Carpenter invention... these alloys are said to be transformed... into products that can be readily hot... worked and turned out in large quan... tities by existing mill facilities.

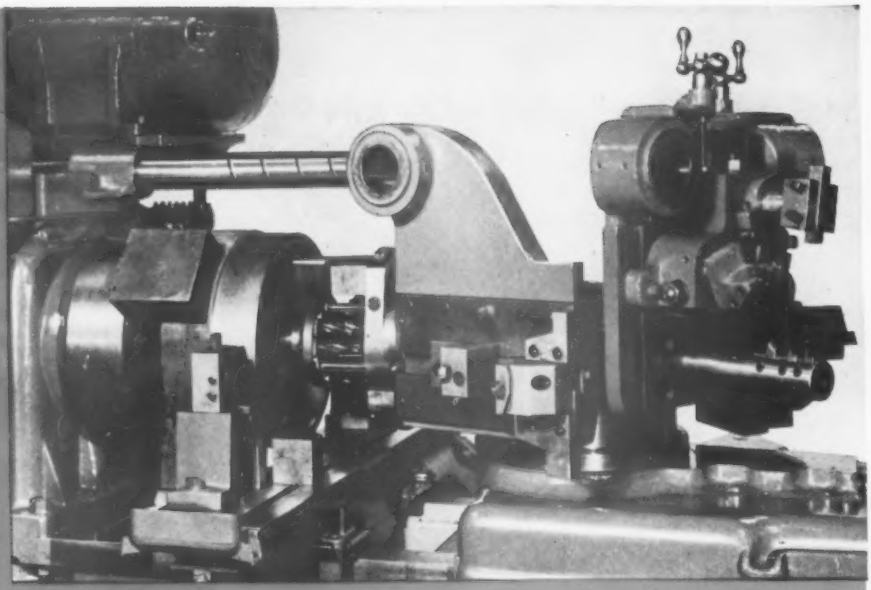
COMPREHENSIVE INFORMATION on por... celain enamel is currently being di... tributed by the Porcelain Enamel... Institute's Government Business Com... mittee. Aim of the program is to... acquaint defense agencies with its ad... vantages as a substitute for critical... materials, particularly in corrosive-... resistant and heat-resistant applications.

The material is resistant to most... acids and alkalies and is currently serv... ing in numerous applications in place... of other critical items.

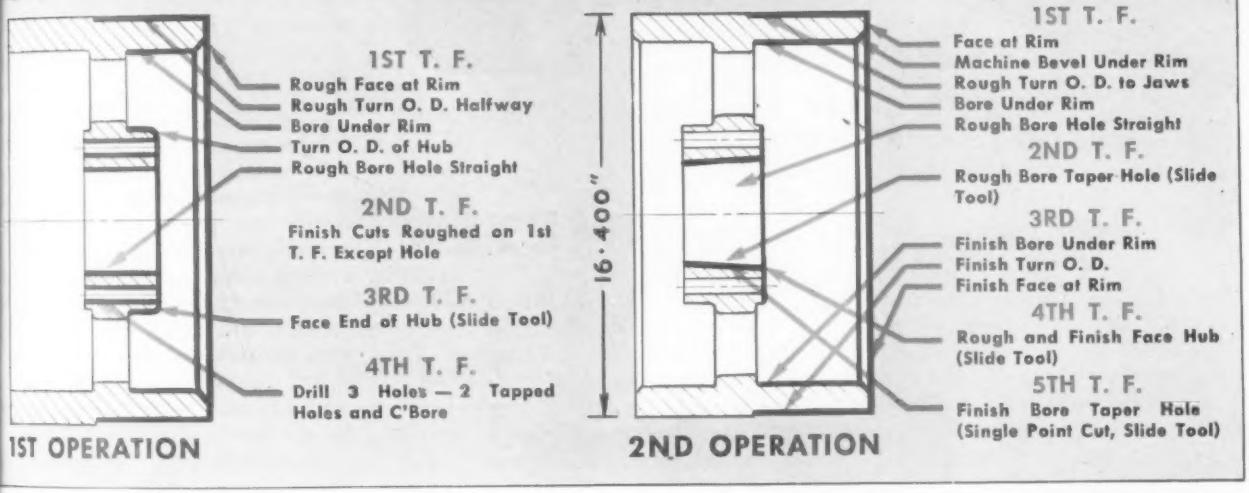
The group also has made an exten... sive study on the use of porcelain enam... eling furnaces for defense purposes. ... P. B. McBride, committee chairman, ... states the survey has revealed that the... demand for new furnaces needed for... heat treating of aluminum and steel is... progressing beyond the capacity of the... producers of such equipment thus cre... ating a need for the conversion of... existing related equipment. With this... fact in mind, the committee has pre... pared a report on the technical aspects... of furnace conversion.

(Continued on page 108)

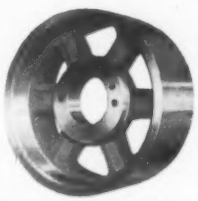
QUALITY CONTROL IN QUANTITY PRODUCTION BEST ACHIEVED WITH P&J CARBIDE TOOLING SET UP ON THE



P&J 5DE AUTOMATIC



You should see it in operation — this typically efficient P&J high-speed method for machining Pulleys on a precision-production basis. The machine best fitted for the job is the P&J 5DE Power-Flex Automatic with its 17 inch swing over the cross-slide. The Tooling on its 5 turret faces and cross-slide consists mainly of P&J's *standard* turret tool units, augmented by P&J-designed slide tools for machining the hub ends and taper hole, and a P&J-designed multiple spindle drill head which is aligned automatically for the proper position of the 5 holes in the hub and which rotates with the work. The cycle of operations is fast and fully automatic . . . results in faster and better machining . . . to closer limits of accuracy . . . with fewer rejects . . . at a highly profitable rate of production.



Numerous similar examples of productivity with P&J Tooling on P&J Automatics are illustrated in this free Booklet. Write for your copy.

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Precision Production Tooling for 53 years

P&J

TECHNICAL SHORTS

(Continued from page 106)

THE ENGINEERING COLLEGE Research Council of the American Society for Engineering Education recently published the 1951 edition of the "Review of Current Research and Directory of Member Institutions". Available for $2.25, it presents a detailed statement describing engineering research in progress in colleges and universities.

The book, which outlines the policies and activities of engineering research in the 91 colleges and universities holding membership in E.C.R.C., is the only complete guide to the current research contributions of engineering schools according to Dr. Gerald A. Rosselot, chairman of the Research Council and director of the State Engineering Experiment Station at the Georgia Institute of Technology. A complete index including more than 4000 entries, facilitates use of the 250-page book.

Copies may be obtained from the Secretary of the Engineering College Research Council, Room 7-204, 77 Massachusetts Ave., Cambridge 39, Mass.

ALSO APPROVED by the ASA recently is a standard for drill drivers, split-sleeve, collet-type, used in the automotive and mass production industries to drive straight-shank twist drills. It is considered particularly suitable for these industry groups because multiple-spindle drill heads can be designed with spindles on a very close center-to-center distance, and bushing plates do not have to be moved when drills must be replaced.

The standard, B5.27-1951, covers drill drivers in nominal sizes from 0.0390 to 0.6875 in. inclusive; specifies dimensions controlling the assembly of the driver with straight shank drills; and the taper controlling the assembly of the driver with the drill press. It also contains recommendations for the material to be used, and its heat treatment; Rockwell hardness; finish; and marking.

A committee organized under ASA procedure and jointly sponsored by the ASME, Metal Cutting Tool Institute, National Machine Tool Builders' Association and the Society of Automotive Engineers developed this standard.

Ninety-nine new and revised standards are listed for the first time in the latest edition of the price list of American Standards recently published by the American Standards Association, 70 East 45 St., New York.

The list contains more than 1180 standard specifications, methods of test, and symbols and abbreviations for various fields.

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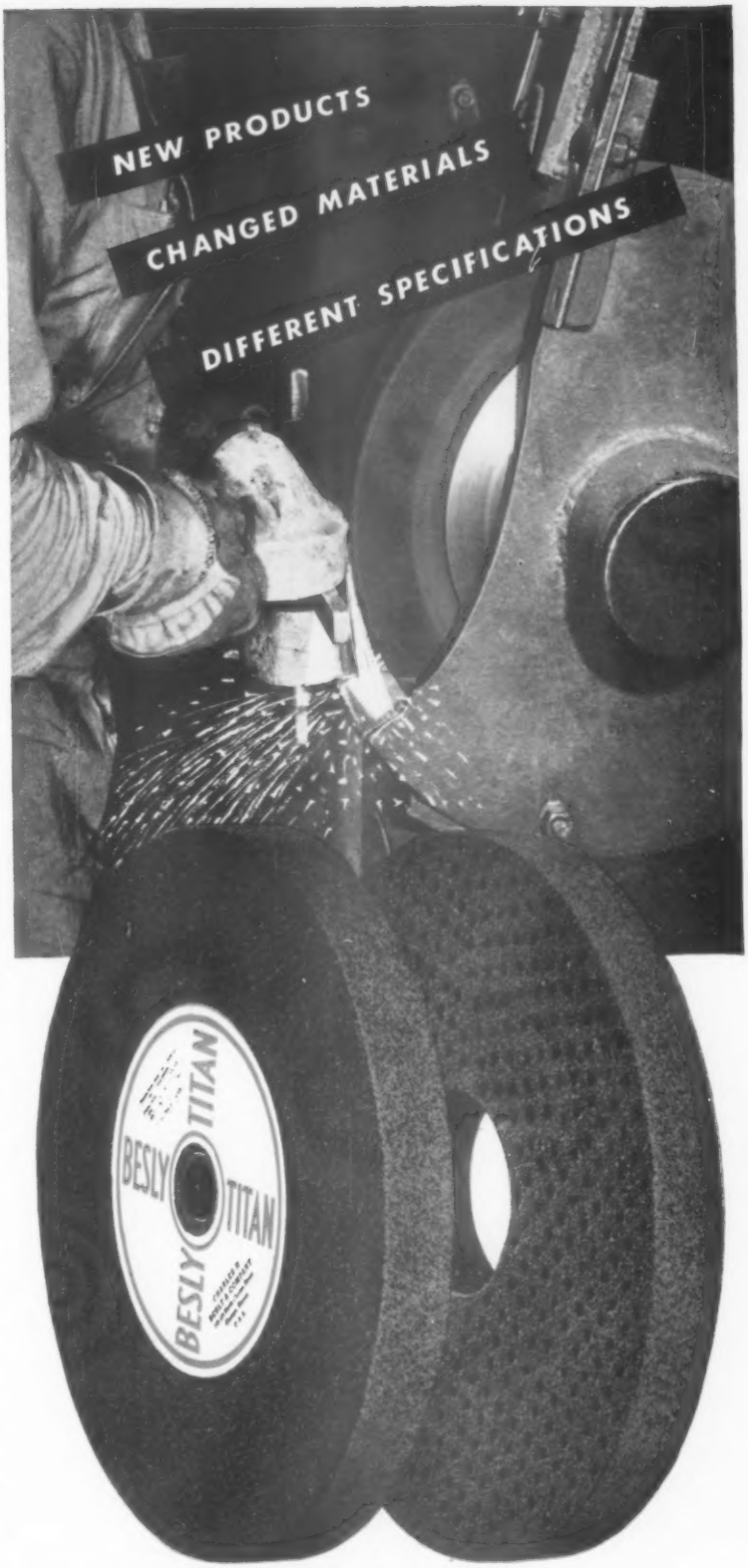

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Changing production schedules mean new products, substitute materials and altered specifications. Each can be handled correctly by abrasive modifications. Besly representatives know products, materials and processes—especially how to maintain high uniformity in production grinding—with every piece the same. Write us to have a Besly-Titan field engineer discuss your grinding needs . . . and ask for a catalog.

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In meeting today's high production demands, it's vitally important to work with abrasive discs and wheels best suited to *your specific needs*. Besly is able to supply you with compounded-to-specification abrasives that will do many jobs better . . . and you can count on deliveries in a matter of *days*—not weeks as might be expected. It pays to have your job specifications filed with Besly for same-week delivery of *made-to-order* wheels and discs.

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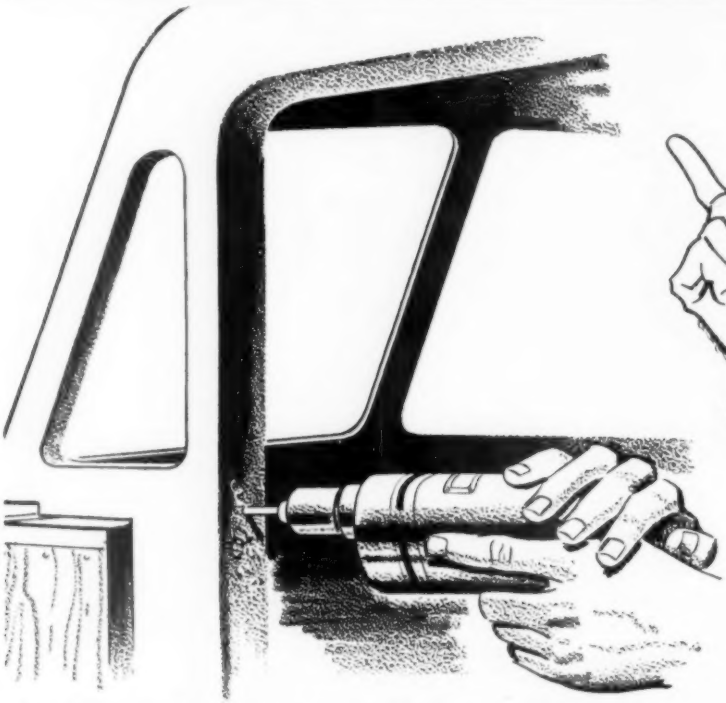
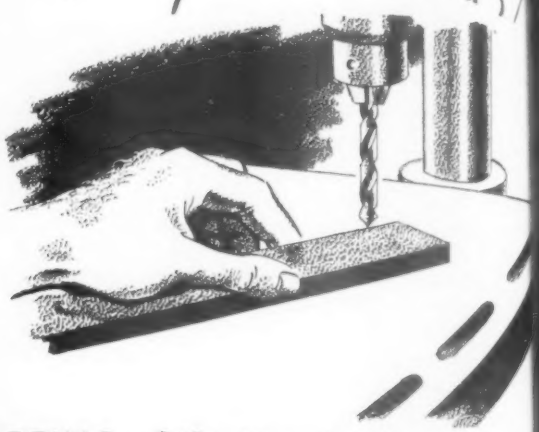
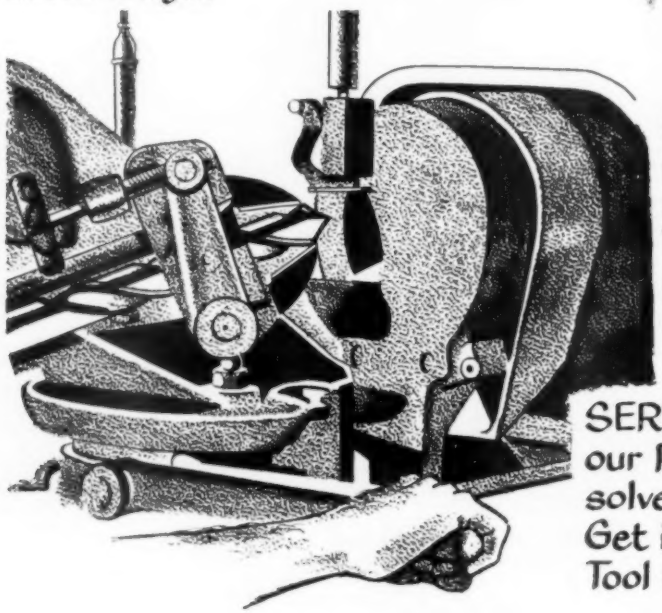
DRILLING POINTERS..... by Red Shield



OVERHEATING. 5/32" jobbers' drills on automotive job were burning and dulling rapidly. We gave them drills with different heat treatment and showed them how to point drills correctly. Now last much longer.





CHIPPING. 3/8" jobbers' drills on plastic part caused chipping. We suggested Standard No. 504 B. Plastic Type Drill and showed them how to point. Now holes are clean. Drills have longer life.

SERVICE. 70 years' experience behind our Red Shield Service Staff... to help solve your metal cutting problems. Get in touch with your local Standard Tool Co. distributor.

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The BELLOWS AIR MOTOR

Built-in Electrically-Controlled Directional Valve

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Built-in Piston Rod Speed Controls

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Requires only a Single Air Connection

Model illustrated — Electrically controlled BEM-5-40 2½" bore, 4" stroke air motor.

The Bellows Air Motor combines air cylinder, electrically controlled air-powered directional valve, and two independent piston speed controls all in one integral power unit . . . a unit that requires only a single air connection which can be made with flexible hose.

Here's compactness and flexibility to the N'th degree. The Bellows Air Motor makes designing for electrically-controlled air operation simple. No bulky power solenoids. No cumbersome, clumsy piping. No complex air circuits.

The unique Bellows ELECTROAIRE* valve gets away from bulk and weight by using the air-power itself to shift the valve, tiny built-in 8-volt solenoid controls to direct it. Makes the whole set-up safe from electrical hazard, safe to operator, safe to machine. The Electroaire valve will operate submerged, flooded with coolant, piled high with chips or dust. And the tiny solenoid control units are guaranteed against burnout!

Integral construction means *quick, responsive power, controlled power, safe power.* For any air cylinder operation the Bellows Air Motor offers maximum effectiveness, minimum over all cost.

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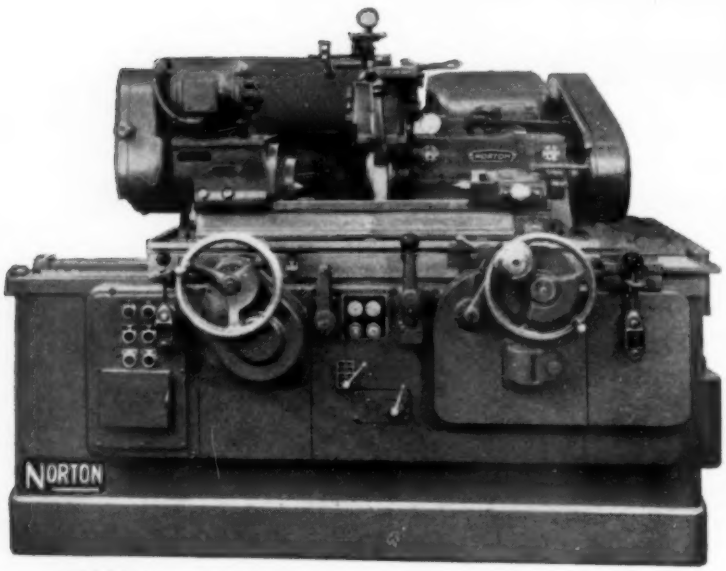
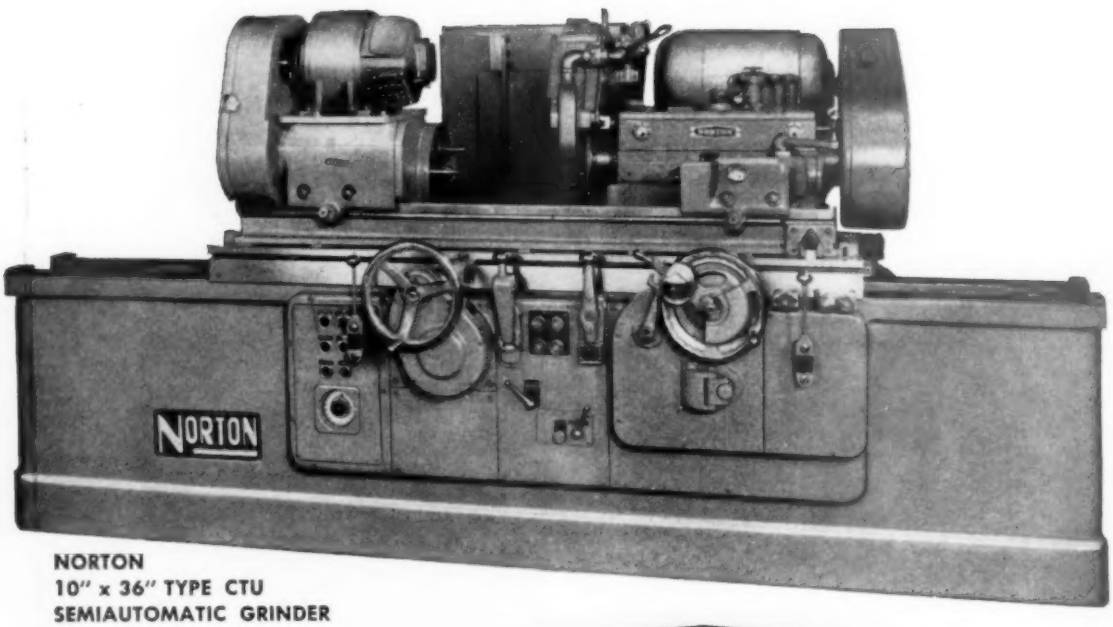
You can make it easier for your operators to produce more with less effort—with NORTON 6" and 10" TYPE CTU SEMIAUTOMATICS



NORTON
6" x 18" TYPE CTU
SEMIAUTOMATIC GRINDER

These Norton Cylindrical Grinders begin paying for themselves right at the start—by easing the operator's job and enabling him to produce more with less effort. With either the 6" or 10" Type CTU machines, he loads the workpiece — touches a lever — and the machine takes over. Work is *automatically* ground to size under electric timer control, after which the wheel head resets itself ready for the next cycle. The simplicity of this "push-button" control, accompanied by a grinding cycle that is mechanically consistent hour after hour, is designed to put profits into your production.

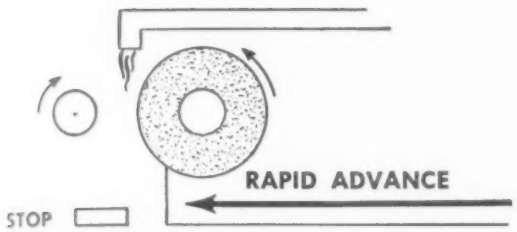


NORTON
10" x 36" TYPE CTU
SEMIAUTOMATIC GRINDER

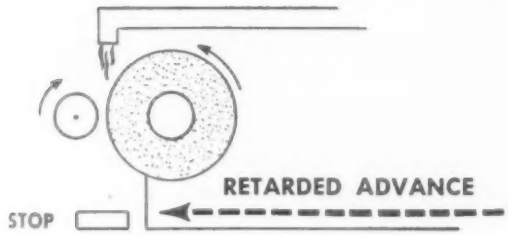
NORTON
GRINDERS and LAPPERS

Making better products to make other products better

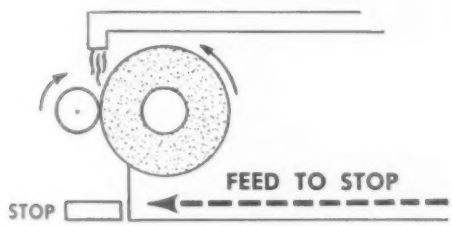
touching one lever produces these automatic functions . . .



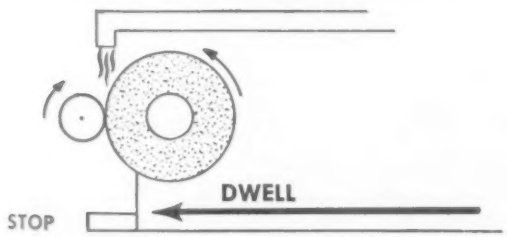
Work rotation starts.
Coolant flows.
Wheel advances rapidly.



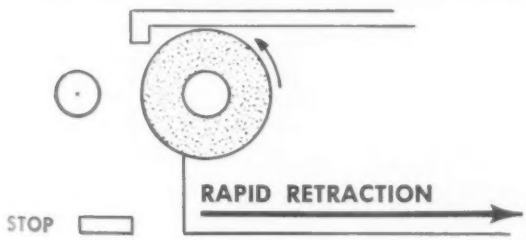
Wheel advance retarded.
Wheel continues to advance at grinding speed.



Grinding continues to preset positive stop.



Wheel dwells for size and finish.



Wheel retracts rapidly.
Work rotation stops.
Coolant shuts off.

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7 OILGEAR VERTICALS AT CHICAGO

The Western Electric Company, outstanding in the manufacture of all types of telephone equipment, has used Oilgear Broaching Machines since 1928. Some of the Vertical Surface Broaching Machines shown above have been in service more than 10 years. The machines in the upper panel finish broach four edges on stampings for crossbar switches. Production for each machine is in excess of 600 pieces per hour. The Oilgear Verticals in the lower panel finish broach two knife edges on steel stampings used as the armatures of crossbar relays. Here too production from each machine is more than 600 pieces per hour.

Oilgear Broaching Machines offer you many advantages as standard which are exclusive with Oilgear or are to be found elsewhere only at extra cost.

Oilgear Machines are often bought to replace other types of equipment and represent tremendous gains both in initial savings and in greatly increased production. This is true in the case of small factories where every capital investment must be carefully made, and in the case of large industrials where production is largely given over to semi-automatic and fully automatic machines, and unfailing dependability becomes just that much more vital. It will pay you to investigate what Oilgear Broaching Machines can do for you. THE OILGEAR COMPANY, 1573 W. Pierce St., Milwaukee 4, Wisconsin

Oilgear

PIONEERS IN FLUID POWER

BROACHING MACHINES AND PRESSES

STELLITE Alloy Tools

machine steel on a mass-production Basis...

With less failure from Chipping

Rear axle housings, like the one sketched above e being machined at the rate of one a minute by AYNES STELLITE 98M2 metal-cutting tools. This oduction schedule is maintained with a minimum tool chipping, even though the operation is com- icated by the size and shape of the part.

This SAE 1010 steel housing vibrates in the lathe it runs at a rate of 287 revolutions per minute. addition, the stock on the barrel and flange is t even. This variation in metal thickness creates uneven cutting action, which subjects the turn- g and facing tools to additional shock.

This is one of those rugged jobs that HAYNES TELLITE tools take in their stride . . . the tools at cut efficiently at red heat and have a good lance of hardness, edge strength, and toughness. ou'll find HAYNES STELLITE tools will lower your sts, because they can take heavy cuts with coarse eds at high speeds.

Write for the booklet, "Operating Information" hich gives the recommended cutting angles, peeds and feeds, and grinding wheels for HAYNES STELLITE 98M2 tools. It is available from our general sales office in Kokomo, Indiana, or any of the district sales offices listed below.

The cutting tools used to machine this rear axle housing are described in the table below.

Tool	Operation	Surface ft. per min.	Depth of cut, in.*
A	Facing	328**	1/16 to 1/8
B	Chamfering	328	....
C	Facing	328**	1/16 to 1/8
D	Turning	254	0 to 1/8
E	Turning	328	1/16 to 3/16
F	Chamfering	328	1/64 to 1/32

*Variation due to non-uniformity of stock

**A diminishes to 213 S.F.P.M.; C to 254 S.F.P.M.

HAYNES TRADE-MARK alloys

Haynes Stellite Company
A Division of
Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Sales Offices
Chicago — Cleveland — Detroit — Houston
Los Angeles — New York — San Francisco — Tulsa

HOW A FEW CENTS CAN MAKE A BIG DIFFERENCE IN PRODUCTION . . .

● As a tool man or production boss, you know what can be done with Talide Tools and Tips.

They cut and machine many times faster, stay sharp longer and remove more pounds per grind. Talide Carbide eliminates hours of "downtime." These advantages, as you well know, mean much longer runs at lower unit cost. In addition, production is increased without buying additional machine tools.

How about consistency of quality? Will your next order of Talide perform as the last lot? The answer is obvious—Talide Tools and Tips are used, year after year, in the best production shops. Sales moved upward every year.

The numbering system for Talide Tools makes ordering and identification easy. Warehouses stock all standard sizes and grades for same-day or 24-hour delivery. Place your order direct with warehouses in Newark, New Jersey; Youngstown, Ohio; Detroit, Michigan; or Chicago, Illinois.

Complete specification, engineering and ordering information is contained in Talide Tool Catalog 50-G, available to you.

SINTERED CARBIDES
METAL CARBIDES CORPORATION
TALIDE
YOUNGSTOWN, OHIO.
HOT PRESSED CARBIDES

METAL CARBIDES CORPORATION

YOUNGSTOWN 7, OHIO *Pioneers in Tungsten Carbide Metallurgy*

CUTTING TOOLS · DRAWING DIES · WEAR RESISTANT PARTS

Your broaching question needs Three right answers

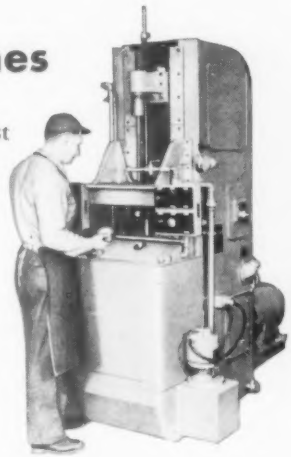
the *American* way gives you all three

1 The RIGHT Tools

Your first right answer from American is the precision quality in every American-engineered broach. American engineers and skilled workers have over thirty years of "Know-How" in design and manufacture, which assures you of the *right* broach for the job.

2 The RIGHT Machines

The next right answer is the machine most capable of performing your job. To select the correct machine, American engineers can choose from *more than 35* standard internal and surface type machines. If yours is a special or unusual job, they can design and build a *special machine* to fit the operation.



3 The RIGHT Fixtures

A highly important answer to broaching accuracy is the work holding fixture. Whether a simple manually operated one — or a complex fixture with automatic clamping and ejection, American fixtures are engineered for fast, accurate and economical production.

Write for the recommendations of the company that builds all three, broaches, broaching fixtures, and broaching machines, for the right answers to your broaching question. Send a part-print or sample and hourly requirements. No obligation, of course. Address Dept. T.

. . . and speaking of threes

Ask about the American 3-Way broaching machine . . . the machine that's easily adapted to push, pull, or surface broaching. Write for Circular No. 100.

AMERICAN *American* BROACH & MACHINE CO.

A DIVISION OF SUNDSTRAND MACHINE TOOL CO.

ANN ARBOR, MICHIGAN

SUNDSTRAND

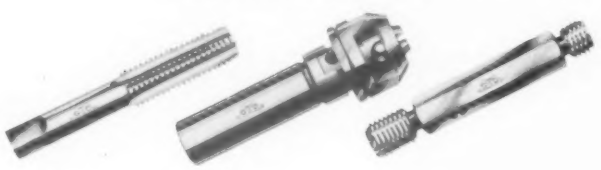
See *American* First — for the Best in Broaching Tools, Broaching Machines, Special Machinery

Machine Ground Tap Flutes

Grinding Tap flutes is not just another operation to improve their appearance. Like Greenfield's precision automatic chamfering, this machine grinding operation imparts one more feature that makes "Greenfield" Taps TOPS.

Why? Because it assures accurate spacing and uniform cutting faces down to the very end of the tap. And the ground flute surfaces provide better chip slippage and disposal.

GREENFIELD TAP AND DIE CORPORATION
Greenfield, Massachssetts



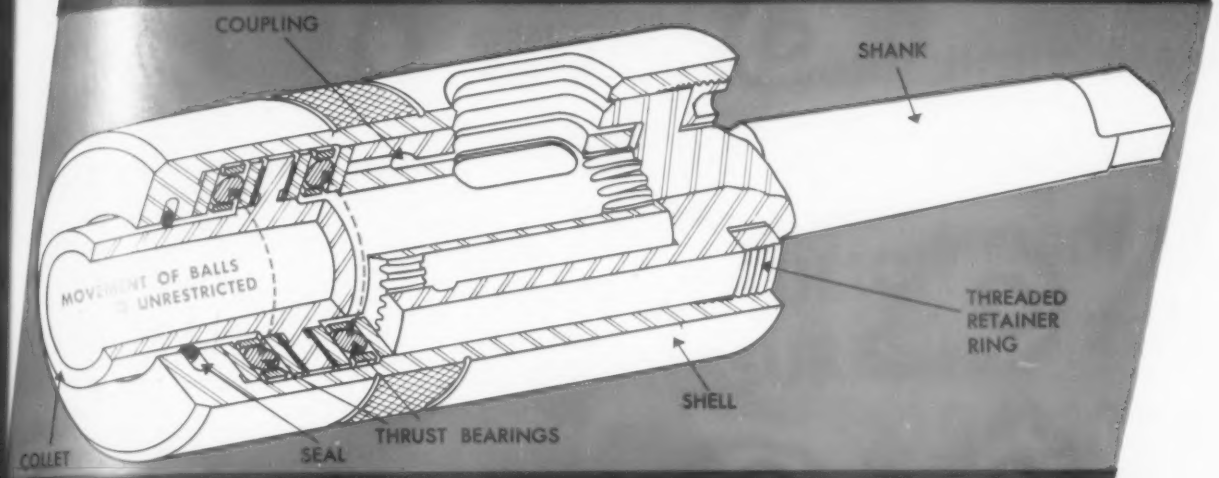
BUY GTD GREENFIELD!

GEOMETRIC TOOL COMPANY DIVISION

Greenfield Tap and Die Corporation

NEW HAVEN 15, CONNECTICUT

for ACCURATE drilling • reaming • tapping



Use SJ SCULLY-JONES "JA" FLOATING HOLDERS

Get these advantages . . . *proven in the field:*

UNIFORM CUTTING OPERATIONS

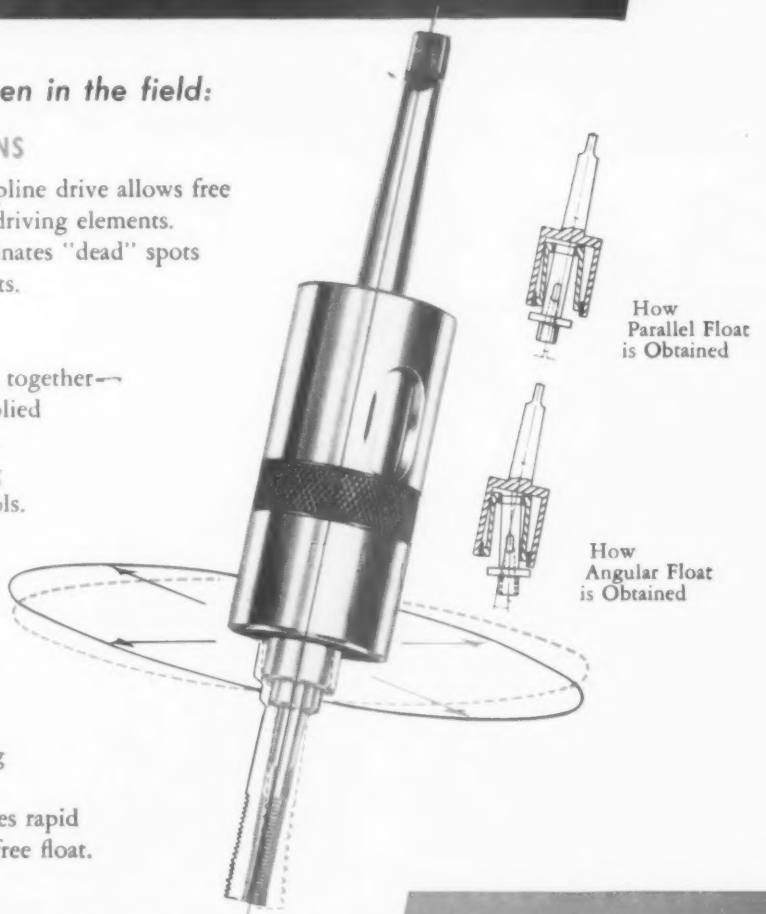
Clearance in the double-gear spline drive allows free movement of the floating and driving elements. This prevents binding and eliminates "dead" spots or zones which often cause rejects.

CONTINUOUS PRODUCTION

Two thrust bearings—placed close together—minimize the effect of the force applied on the tool by the hole. Thus, tools float freely into alignment—reducing down time and damage to cutting tools.

TROUBLE-FREE OPERATION

Balls are free to move in the required direction or rotate around the collet, because the floating element is separated from the drive. Free movement of the balls eliminates confined reciprocating motion. This greatly reduces the scrubbing action characteristic of small rocking movements. The scrubbing action often causes rapid destruction of ball-thrust plates and prevents free float.



How Parallel Float is Obtained

How Angular Float is Obtained

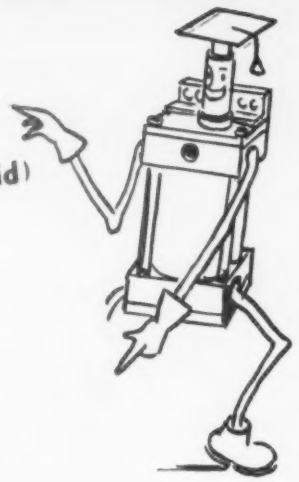
Write for Bulletin No. 8-50
showing complete range of sizes, specifications and prices.

Scully-Jones AND COMPANY
1915 S. ROCKWELL ST., CHICAGO 8, ILLINOIS

YOU GET LOW COST, FAST, ACCURATE PRODUCTION WITH OUR STANDARD AND SPECIAL TOOLS

BOOST 80 PSI AIR

(Input Range: 40 to 3000 psi Air or Fluid)



TO . . . 2000 PSI HYDRAULIC PRESSURE

(Output Range: 200 to 10,000 psi Fluid)

with Miller

Fluid Pressure BOOSTERS

From ordinary plant air line pressure, Miller Boosters produce hydraulic pressures (from 200 to 10,000 psi) for driving one or more hydraulic work cylinders simultaneously at from 30 to 450 strokes per minute. Ordinarily, the booster operates one stroke for each stroke of the operated work cylinders.

Used in place of conventional type hydraulic pumps, Miller Boosters save space and weight, permit convenient portability and are easier and less costly to install, operate, and maintain. Also, they hold pressure *indefinitely —without the motion and heat generation of ordinary pump circuits.*

Used in place of air cylinders, the booster driven hydraulic work cylinder, which can do the work of an air cylinder ten times as large and heavy, saves space and weight at point of application of cylinder thrust—since the booster itself can be mounted separately—away from the hydraulic work cylinder—and either on or off the equipment or machine.

In many installations, the popular Miller Dual Pressure "Air Miser" Booster *saves up to 95% of the air* normally consumed by direct-driven air cylinders.

A wide selection of sizes, pressure ratios and mounting styles are available for the first time at low cost on a normal delivery schedule because Miller Boosters are built up from stock Miller standard cylinder parts to eliminate costly designs, patterns and castings.

pecially ommended for . . .

- WELDING
- PUNCHING
- SHEARING
- CLAMPING
- RIVETING
- CRIMPING
- PRESSING

and SIMILAR APPLICATIONS

Full Details In Miller Bulletin B-200 Sent FREE On Request

OTHER MILLER PRODUCTS INCLUDE: AIR CYLINDERS, 1½" to 20" BORES, 200 PSI OPERATION; LOW PRESSURE HYDRAULIC CYLINDERS, 1½" TO 6" BORES FOR 500 PSI OPERATION, 8" TO 14" BORES FOR 250 PSI; HIGH PRESSURE HYDRAULIC CYLINDERS, 1½" TO 12" BORES, 2000-3000 PSI OPERATION. ALL MOUNTING STYLES AVAILABLE.

Miller

MILLER MOTOR COMPANY

2010 N. HAWTHORNE MELROSE PARK, ILL.

AIR AND HYDRAULIC CYLINDERS · ACCUMULATORS · COUNTERBALANCE CYLINDERS · BOOSTERS · AIR HOISTS

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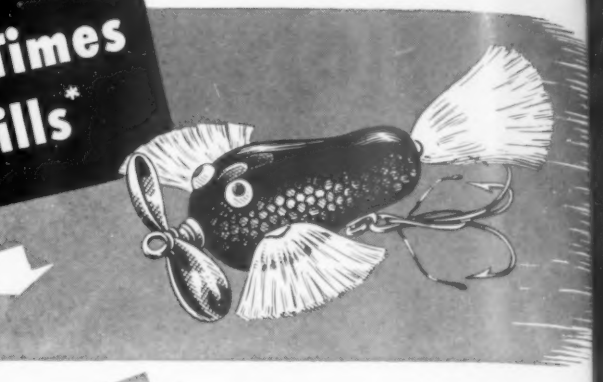
HARTFORD — NEW YORK CITY — DAYTON — ST. PAUL — FORT WAYNE — INDIANAPOLIS
MILWAUKEE — NASHVILLE — SEATTLE — LOS ANGELES — SAN FRANCISCO — BALTIMORE
ST. LOUIS and OTHER AREAS

s and Service from coast to coast

Output Multiplied Ten Times with Keller Airfeedrills*



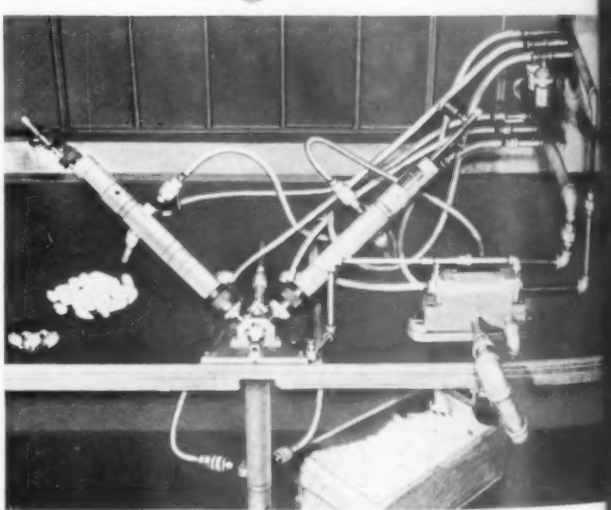
In a shop that makes molded plastic fishing lures, each unit must be drilled with five tiny odd-angled holes for attaching leader, hook, fins, tail, and eyes.

With a conventional drill press and tumble jig, a workman could drill about 800 units a day, which placed a top limit on production.

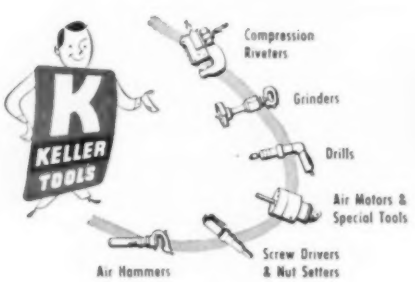
Then fixtures were designed to make use of Keller Airfeedrills*. With this equipment, several holes are drilled simultaneously by pressing a single control valve. Each drill advances, drills, retracts, and shuts off automatically.

Today, the workman can drill 8,000 of these units a day—ten times his former production. And when his run has been completed, the Airfeedrills are easily, quickly detached for use on other fixtures and other jobs, minimizing investment and idle time of equipment.

Probably Keller Airfeedrills can help speed your production . . . we will gladly discuss it with you.

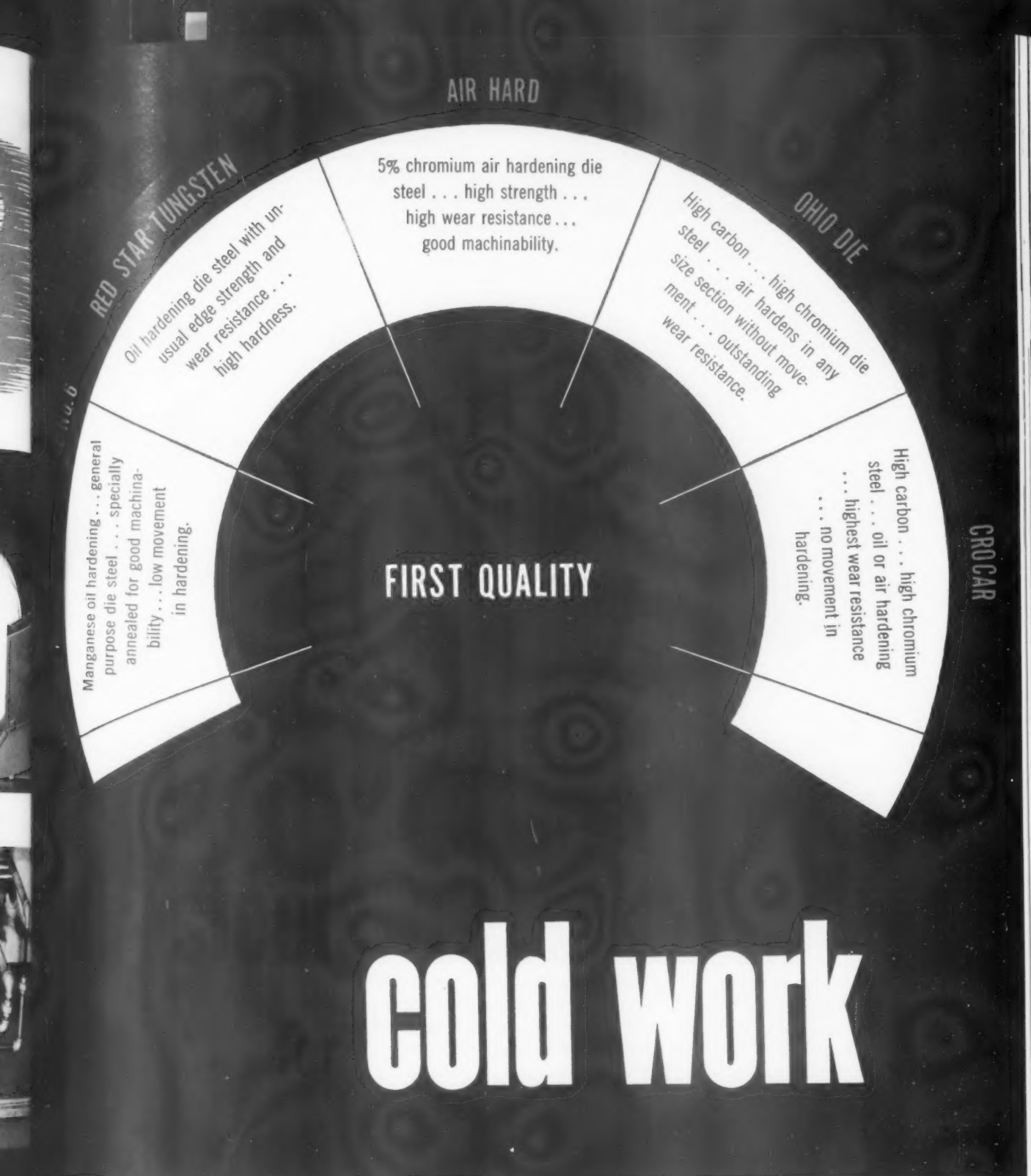


*Keller Tool Company Trade Mark



KELLER
Pneumatic Tools

KELLER TOOL COMPANY, GRAND HAVEN, MICH



cold work

These Die Steels for Cold Work are designed to cover every performance requirement, and for adaptability to available heat treating facilities. Each grade is carefully annealed and fully inspected by magnaflux, reflectoscope and deep etching to insure First Quality selection. Our Representative in your area will gladly assist you with your needs.

Write for your free copy of our detailed metallurgical brochure on "Die Steels for Cold Work."

Vanadium-Alloys
STEEL COMPANY
LATROBE, PA.

COLONIAL STEEL DIVISION • ANCHOR DRAWN STEEL CO.

Q: But we've always done this job mechanically. Why should we change to hydraulic or pneumatic cylinders?

A: You can save time, reduce physical effort, cut operating costs! We know, because our experience includes a number of jobs just like yours where cylinders were the answer.

Do All you CAN do... with Hannifin Hydraulic or Pneumatic Cylinders

If you want to **PUSH · PULL · LIFT · PRESS · CLAMP · SQUEEZE** . . . let Hannifin cylinders do the work! There are almost unlimited ways in which cylinders can be used to operate work-saving devices.

And, the Hannifin line of hydraulic and pneumatic cylinders includes the widest variety of standard mounting combinations, to enable you to get the cylinder that meets your needs—exactly!

A Suggestion: Call a Hannifin field engineer, or write for recommendations you can use—PROFITABLY!

Hannifin Corporation, 1119 S. Kilbourn Ave., Chicago 24, Ill.

Field Engineers in All Leading Industrial Centers

IN HYDRAULIC CYLINDERS ALONE, Hannifin builds 11 standard mounting styles, offering remarkable adaptability to a wide range of applications. An infinite number of custom cylinder designs are available. However, special cylinder problems are frequently solved with over 50 "combination mountings" made up of standard parts. *Ask for Bulletin 110.*

Here are 3 Popular Types

JN—Flange mounting, rod end —sizes 1" to 8" bore.

CN—Foot mounting—sizes 1" to 8" bore.

DN—Trunnion mounting—sizes 1" to 8" bore.

HANNIFIN ENGINEERING SERVICE

Opportunities to improve operations and cut costs through the proper use of hydraulic and pneumatic equipment are numerous. For these reasons, Hannifin maintains a full staff of experienced engineers to help you find the right answer. ASK FOR THEIR SUGGESTIONS.

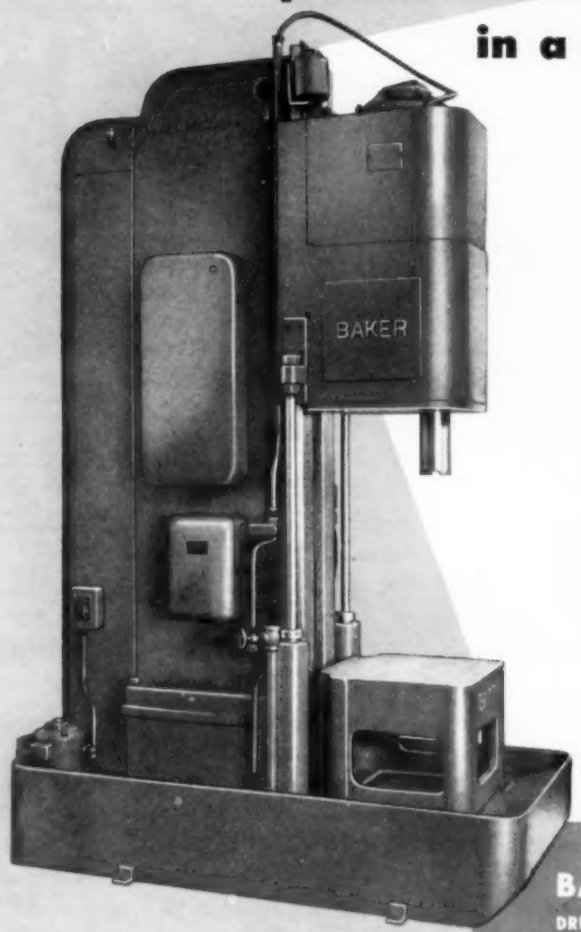
HANNIFIN

Air Cylinders • Hydraulic Cylinders • Hydraulic Presses
Pneumatic Presses • Hydraulic Riveters • Air Control Valves

BAKER

The Versatile BAKER 36HO DRILL...

provides increased productivity in a multitude of applications!

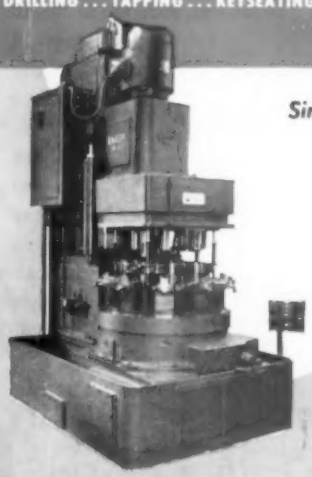


The standard Baker 36HO Heavy Duty Vertical Hydraulic Drill may be adapted to a multitude of multiple or single spindle drilling, boring, counterboring, spot facing or reaming operations. Provision for pick-off speed changeovers gives extreme flexibility of spindle speeds. The machine is of hydraulic saddle type feed and may be furnished with either standard plain table or indexing table with up to six indexing stations. Ample capacity is provided to drive one 5 inch diameter High Speed twist drill, drilling from solid in SAE-1035 steel. Write Baker concerning your specific job problem.

BAKER BROTHERS, INC., Toledo, Ohio

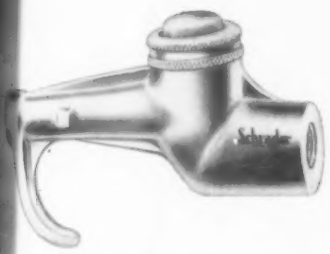
DRILLING ... TAPPING ... KEYSEATING and CONTOUR GRINDING MACHINES

Illustrations show Baker 36HO as adapted for drilling wrench bodies for a leading manufacturer of crescent wrenches. Estimated production rate is 103 parts per hour at 100% efficiency. Machine is easily converted for operations on varying sizes of wrenches.



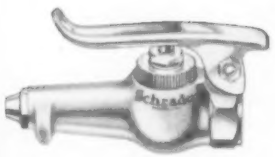
Since 1867...

There is a Schrader® blow gun for every job

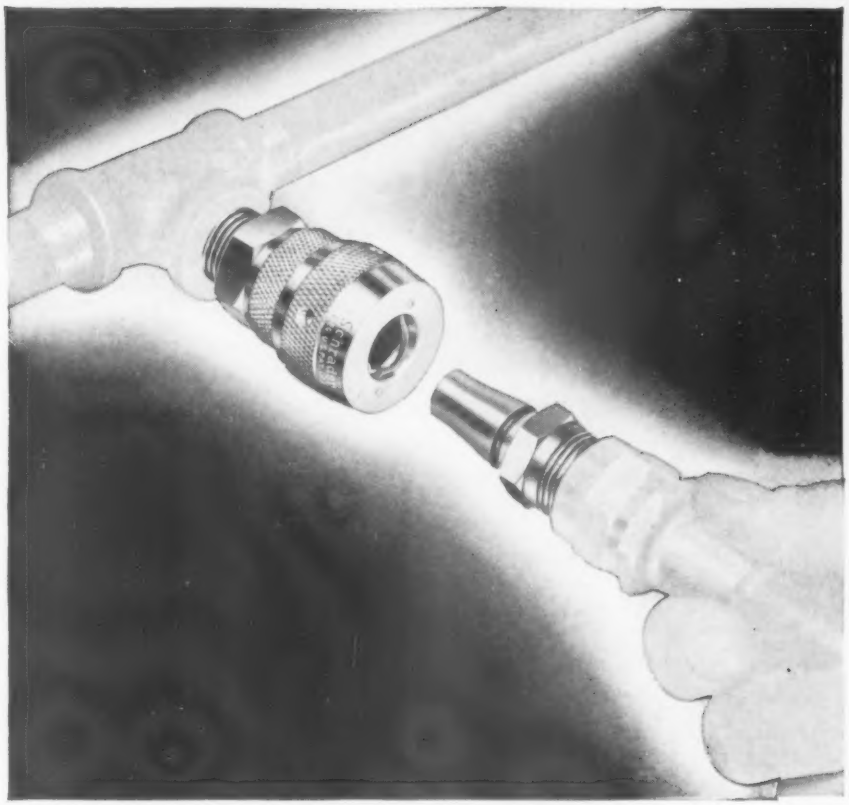


This drop forged stainless steel blow gun is designed to stand up under hard, steady use. It is practically indestructible. The stainless steel construction increases corrosion resistance and gives you a positive guarantee of longer, trouble-free service.

Button Type—This sturdy all-purpose forged brass blow gun operates at the press of a button. A popular all-round blow gun that has proved indispensable to hundreds of thousands of users.



Lever Type—A controlled flow of air, from a puff to a blast, is a feature of this precision-control blow gun. Its design and lever position provides a natural grip for thumb control of air flow.



Now Compressed Air can be as convenient as electricity

With Schrader Quick Acting Couplers you can have air where you want it and when you want it—with the "plug-in" convenience of electricity. They can be installed at handy places along walls, benches or columns . . . bringing air right to the "point of work."

A quick push snaps the Schrader swivel adapter into the check unit . . . opens line pressure and locks to make an air-tight connection. It requires only a positive manual twist of the check unit sleeve to uncouple. These fittings come in a variety of adapter and thread sizes.

The Schrader Tuck-Away Hose Reel is another item for more convenient

handling of compressed air. This reel will keep air lines off the floor, reduce accidents, lengthen the life of the hose. Schrader Hose Reels are the efficient way to bring air to the work.

These are just two of the many Schrader air line fittings that can help you make air as convenient to use in your shop as electricity. Ask us to help you determine what will best fit *your* needs. Send us a letter outlining your particular installation, your idea, or fill out the coupon below.

Air Cylinders • Operating Valves • Press & Shear Controls • Air Ejection Sets • Blow Guns • Air Line Couplers • Air Hose & Fittings • Hose Reels • Pressure Regulators & Oilers • Air Strainers • Hydraulic Gauges • Uniflare Tube Fittings

Schrader
PRODUCTS
CONTROL THE AIR

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A. Schrader's Son
Division of Scovill Manufacturing Company, Incorporated
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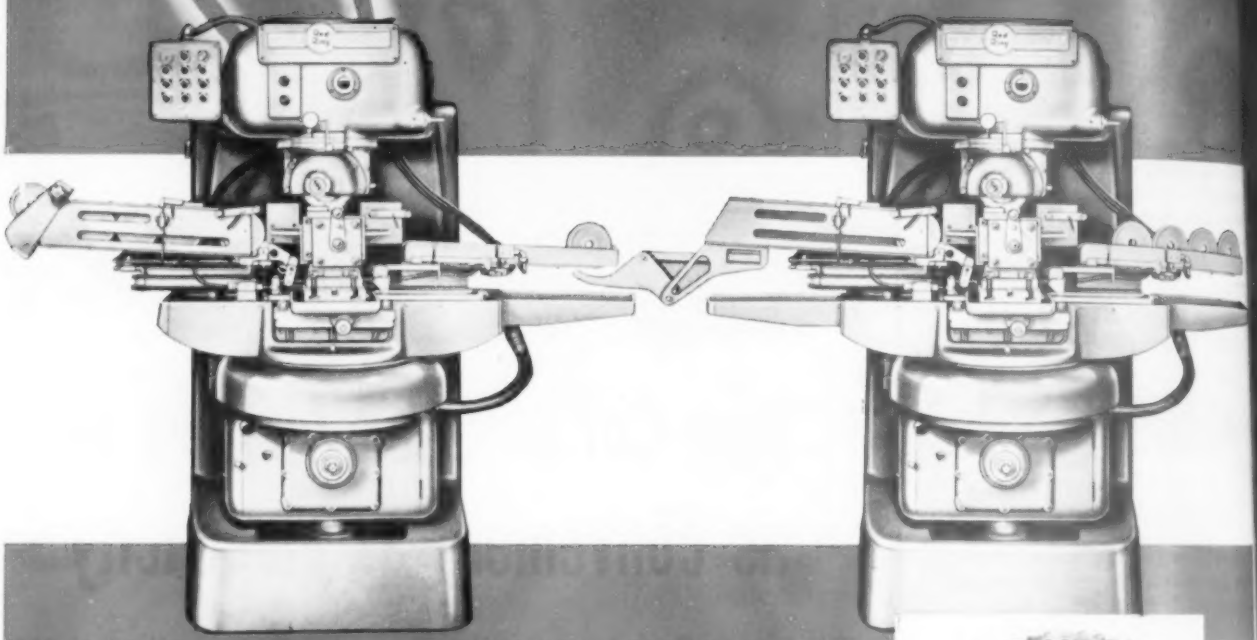
Please send me further information on Schrader Air Line Fittings and Blow Guns.

Name _____ Title _____
Company _____
Address _____
City _____ Zone _____ State _____

RED RING Straight Line Automatic Loader

Saves Time and Conserves Manpower

In Shaving Cluster Gears



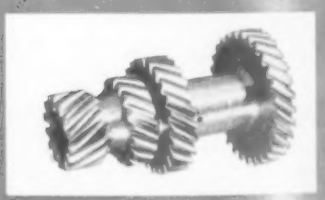
This new Red Ring Loader puts the shaving of cluster gears on a continuous automatic basis with important savings in time and manpower.

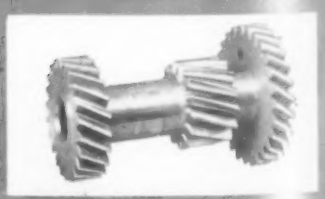
Although the illustration shows a battery for shaving a two step cluster, additional machine units may be added for as many additional steps as necessary.

All machines in such a battery are synchronized, but each unit is individually controlled and may be individually operated when desired. Each incorporates the universally accepted crossed axes principle of shaving.

A single operator is needed merely to supply unshaved gears to the magazine feed of the first machine and to remove the completed gears from the discharge chute of the final machine. All handling between machines is done by the automatic mechanical transfer mechanisms. All operations are in full view of the operator at all times.

Write for full description and savings.





SPUR AND HELICAL GEAR SPECIALISTS

ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORM

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN . . . . . DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

SIDNEY HEAVY DUTY LATHES

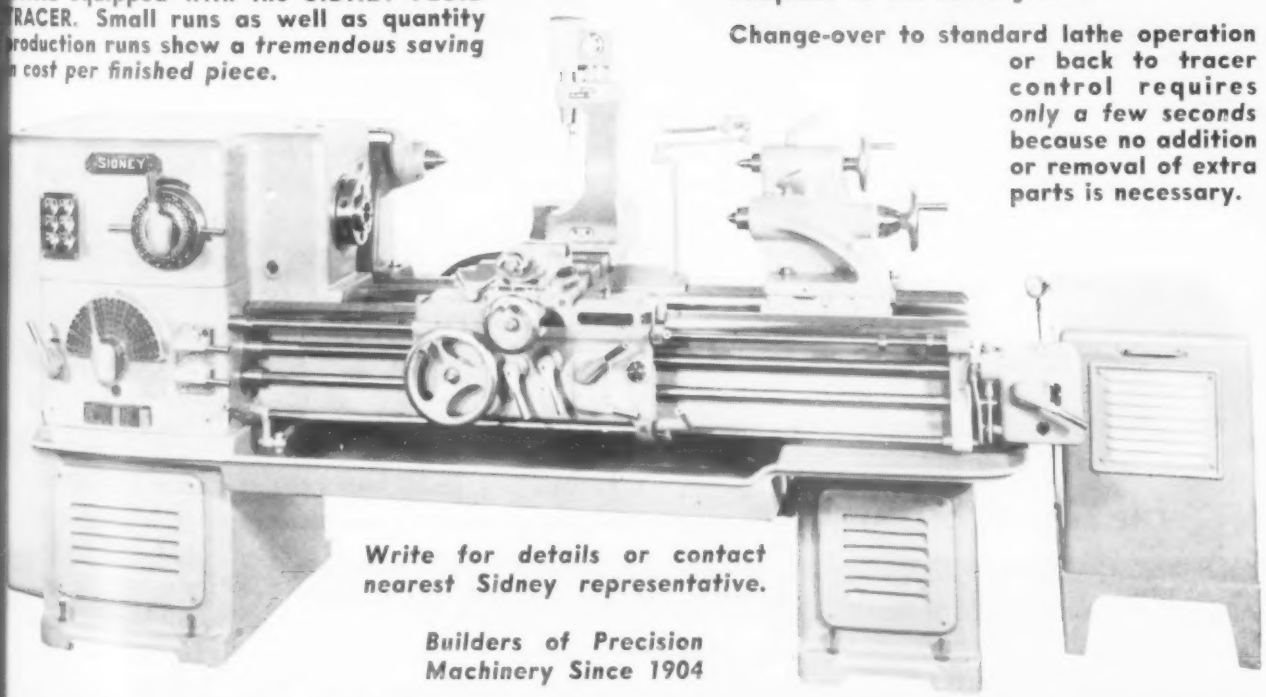
SOLVE YOUR PRODUCTION PROBLEMS

TURN ANY SHAPE .. ANY NUMBER .. FASTER .. MORE ECONOMICALLY

The variety of shapes and sizes illustrated shows the versatility of the SIDNEY LATHE equipped with the SIDNEY FLUID TRACER. Small runs as well as quantity production runs show a *tremendous saving* in cost per *finished piece.*

The sensitive tracer head transfers every change in contour of the master piece or template to the cutting tool.

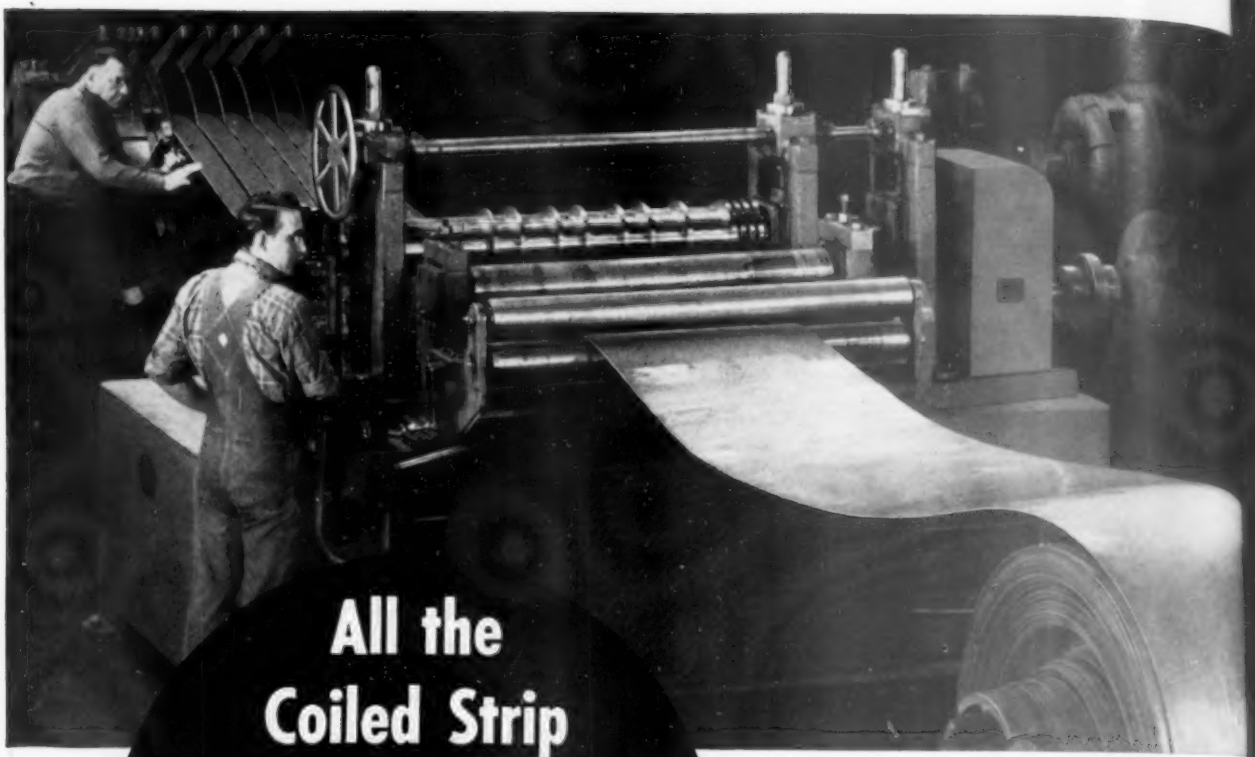
Change-over to standard lathe operation or back to tracer control requires *only a few seconds* because no addition or removal of extra parts is necessary.



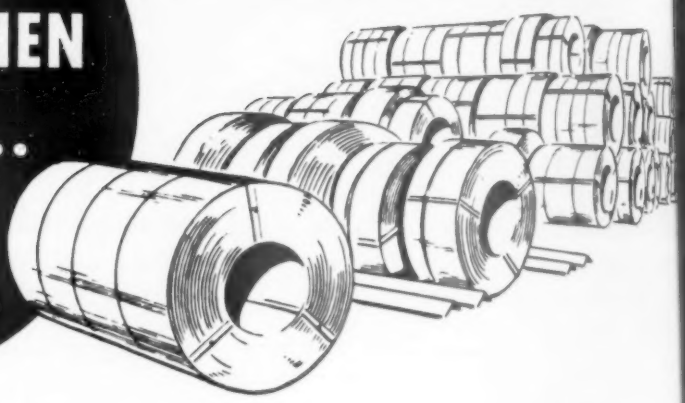
Write for details or contact nearest Sidney representative.

Builders of Precision Machinery Since 1904

SIDNEY MACHINE TOOL COMPANY • SIDNEY, OHIO



All the Coiled Strip You Need...WHEN You Need it... At LOWER COST!



You will find it ever so much easier to have all these things when you install a Yoder Rotary Slitter. The sources of supply of mill-width stock are obviously much more numerous, prices per ton much lower, and deliveries much quicker than on slit-to-width strands.

Not only that, but your stock becomes more flexible—goes farther—when mill-widths can in a few hours be slit to the desired widths in your own shop. Many fabricators have reduced inventories from 40 to 60% by investing in a Yoder slitter.

Production planning becomes easier, too, when expected and unexpected needs for any width can be so quickly and easily met.

Besides all these advantages, direct savings may range from $5.00 to $50.00 per ton, depending on widths, quantities and other factors. On requirements as low as 1000 tons per year, a Yoder slitter often becomes a most profitable production tool. Get the facts! Send for 78-page book on the Economics as well as the Mechanics of doing your own slitting.

THE YODER COMPANY • 5525 Walworth Avenue • Cleveland 2, Ohio

Complete Production Lines

- ★ COLD-ROLL-FORMING and auxiliary machinery
- ★ GANG SLITTING LINES for Coils and Sheets
- ★ PIPE and TUBE MILLS–cold forming and welding

ENGINEERING YODER MANUFACTURING

For those tough *Special* jobs . . . depend on

NATIONAL TOOL CO.

and our field representatives from coast to coast

Since 1905 **engineers and manufacturers of high-quality special cutting tools for the metal-working industry**

● **National Tool Co. engineers are backed by years of successful experience in special tooling and related problems. Their assistance is yours for the asking—whether you're interested in one tool or the tooling program for a whole plant.**

A PARTIAL LIST OF *Special* TOOLS ENGINEERED AND MANUFACTURED BY

Gear Shaper Cutters	Milling Cutters	Chamfering Cutters
Herringbone Gear Cutters	Broaches	Rotary Gear Cutters
Ground and Unground Gear and Spline Hobs	Tungsten Carbide Tools	Circular Form Tools
Master Gears	Sprocket Cutters	Gang Cutters
	Profile Form Mills	Flat Form Tools

NATIONAL TOOL CO.
Cleveland 2, Ohio

Representatives in major industrial centers

You don't need this...

when you use this...

"RED END" BLADE

That's right! Simonds "Red End" Hacksaw Blades take less elbow grease . . . cut smooth and easy with less effort. *That's why workers like 'em so much.* And why shouldn't they? You can get "Red End" Blades for any hand job (power jobs, too) . . . made from quality-controlled steel poured in Simonds' own mills . . . and they're made right! So if you want more cutting per blade-dollar, specify "Red End"...that's for *you.* Buy through your Simonds Distributor.

THREE TYPES

STANDARD STEEL	HIGH SPEED (Molybdenum)	HIGH SPEED (Tungsten)

Hard Edge or All Hard

A "Right" Blade For Every Job!

SIMONDS SAW AND STEEL CO.

FITCHBURG, MASS.

Branch Offices in Boston, Chicago, San Francisco and Portland, Ore.
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Let us assume
full, undivided responsibility

TWENTY-TWO YEARS EXPERIENCE IN MANUFACTURING PRECISION HONING EQUIPMENT

MICROHONING MACHINES

MICROHONING FIXTURES

MICROHONING TOOLS

MICROHONING ABRASIVES

DEVELOPMENT-ENGINEERING

TECHNICAL SERVICE

The MICROMATIC HONE CORPORATION has been the principal manufacturer of honing equipment for the past twenty-two years. In that time we have designed and put into production thousands of honing installations. An active research and development program has always been maintained. This has resulted in the development of a new, more precise, production process—MICROHONING.

We have the most complete line of Microhoning machines, fixtures, tools (all designed and manufactured in our own plant) available anywhere. We stock and process honing stones manufactured by the three largest abrasive manufacturers in the country. This, plus a staff of Engineers and Service Technicians that have the greatest honing know-how of any organization in the world, warrants us asking that you LET US ASSUME FULL, UNDIVIDED RESPONSIBILITY FOR THE RESULTS OBTAINED WITH YOUR MICROHONING EQUIPMENT.

MICROMATIC HONE CORPORATION

8100 SCHOOLCRAFT AVENUE • DETROIT 4, MICHIGAN

District Field Offices: 1323 S. Santa Fe Avenue, Los Angeles 21, California • 206 S. Main Street, Rockford, Illinois • 231 S. Pendleton Avenue, Pendleton, Indiana • MICRO-MOLD Manufacturing Division, Boston Post Road, Guilford, Connecticut • 55 George Street, Brantford, Ontario, Canada

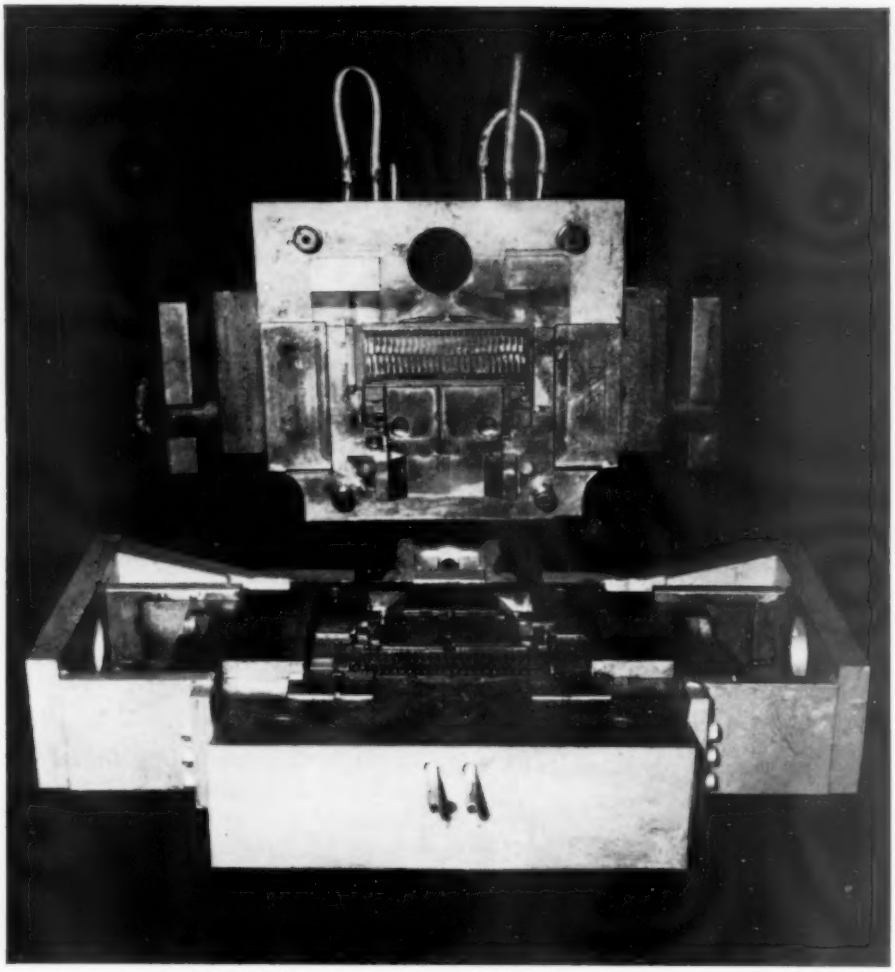
Micromatic *

MICROHONING

*Reg. U. S. Patent Office

Write today for CROSS-HATCH describing the MICROHONING *process*

WORLD LEADING MANUFACTURER OF PRECISION HONING EQUIPMENT



No matter what your DIE-CASTING JOB may be...

Accuracy calls for POTOMAC M Hot Work Die Steel

"HOT-WORK STEELS"

is the title of a new, six-page folder that tells about the chromium, molybdenum, vanadium Hot Die Steel known as POTOMAC M—and also covers other grades for other hot-work operations. Secure your copy —*write today!*

ADDRESS DEPT. TE-21

In the precision casting of aluminum, POTOMAC M Hot-Work Die Steel is especially favored as the material for die-casting dies because its properties help assure accuracy of the steel itself *after* heat treatment. Die makers have found that size changes are held to a minimum. Dimensional stability is thus the *first* contribution that POTOMAC M makes to accuracy.

Production accuracy of the die after it is in service is maintained also by the resistance of POTOMAC M to wea to heat checking, and to metal was

Allegheny Ludlum makes a comple line of steels for hot-work tooling o various kinds—so, whether your nee is the mass producing of duplica parts or fabricating a few of them, ca up or write "A-L" every time fo hot-work counsel or service or both Just tell us your requirements.

● *Allegheny Ludlum Steel Corporation Henry W. Oliver Bldg., Pittsburgh 22, Pa.*

For complete **MODERN** Tooling, call

Allegheny Ludlum

W&D 3724

AL FINE TOOL STEELS SINCE 1854

Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributors: Bethlehem Steel Export Corporation

High H Shear Blades Blame for Idle Time

ther day a Bethlehem salesman was ised to find one of his good cus- , a shop boss, in a somewhat hostile for no apparent reason. "You've e in real trouble," the boss said. mber that Lehigh H steel you sug- we use for shear blades?"

hy, yes, I do," admitted the salesman. ell, come with me," replied the cus- . "I want to show you something." ey walked out in the shop where the blades were used to cut steel and strip. So far as the Bethlehem man see, the blades seemed to be work- ine. He looked at the customer and ime he detected a twinkle in his eye.

Leisure for Tool Grinder

that fellow over there?" And the mer pointed to a workman who was ng the morning paper. "That's our grinder, and he's a good one, too. He to spend most of his time grinding s. But those blades we made out of gh H just seem to last forever. And y morning I have to rack my brains d something else for him to do!"

he boss had a good laugh. Then he the salesman an order for more gh H tool steel. He could afford to his tool grinder idle much of the time. shearing costs had been sliced in half.

igh-carbon, high-chromium Lehigh H st what the experienced toolmaker s wherever maximum wear and mum distortion are important. It's hardening, safe for intricate dies, sections, sharp corners. And it's -hardening, with high compressive gth for heavy-duty tools and dies.

Ten Times More Necktie Clasps with Hobbed Molds of Duramold A

Here's another enthusiastic report on Duramold A, our 5 per cent chromium, air-hardening hobbing steel. Hobbed for zinc die castings, this special-purpose steel has upped the life of molds by at least 1000 pct, according to Peerless Engineering Co., Inc., South Gate, Calif. In the casting of novelty necktie clasps, the die sets of Duramold A were examined at a time when previous molds had to be discarded. The Duramold A cavities showed no evidence of checking or sinking; and the surface finish appeared to have actually improved with use.

M. T. Derby, chief tool engineer for Peerless, sums it up:

"We like Duramold A because it's easy to hob. In making multiple cavities we get good detail and accuracy with fewer machine-hours. For most of our work we need a steel that gives us a high polish in the cavities with a high hardness that will stand up under zinc-injection molding at high pressures and temperatures. We've found Duramold A to have good core strength, it doesn't sink readily, and we can expect to get long runs with very little maintenance."

Whether used for die-casting or plastic-molding Duramold A is a real improvement over hard-to-hob steels. Its 5 pct chromium content provides plenty of wear-resistance and core strength . . .

Duramold A is hobbed in one push in a 300-ton press by the master hob shown at top. Eight necktie clasps are cast at one time, the molten zinc being injected at 800 F and 2000 psi; mold temperatures reach about 500 F.

and its air-hardening properties hold distortion to a minimum during heat-treatment.

Its typical analysis:

C	Mn	Si	Cr	Mo
0.07 max	0.40	0.20	4.50	0.45

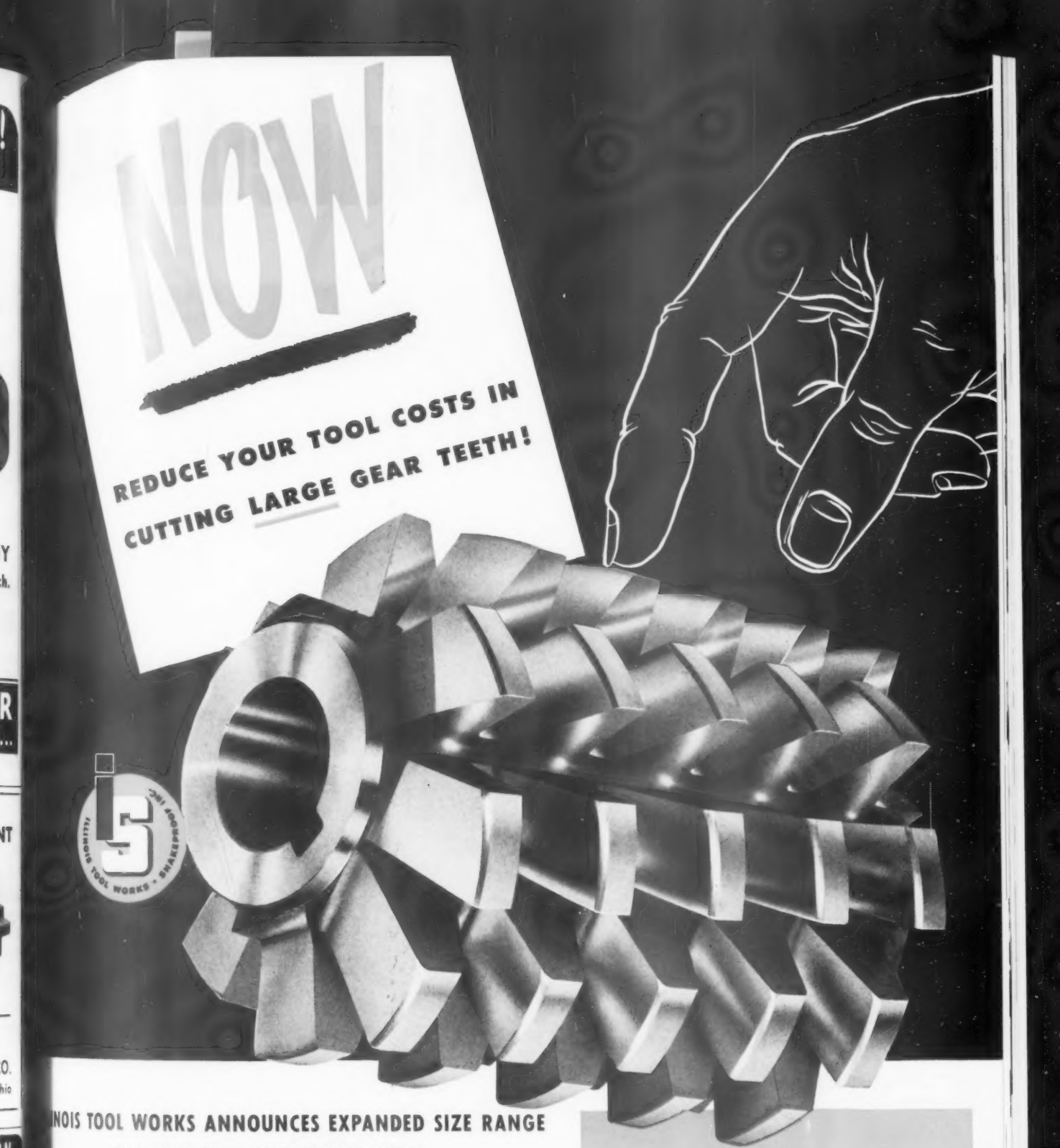
Booklet 271 will help you select the right tool steel — for hobbed molds, machine-cut molds, or master hobs. Address your request to our Publications Department, Room 1041, Bethlehem, Pa.

Our Tool Steel Engineer Says:

Poor tool design can cause cracking in heat-treatment

Proper attention paid to tool design can often prevent the cracking of tools during heat-treatment. Too often the heat-treater is asked to harden tools which cannot be quenched properly. One frequent design fault is a tool having a heavy section adjacent to a light section. Unnecessarily sharp corners is another design fault that can cause cracking. Provide fillets wherever sharp corners are not essential.

Bethlehem ULTRASONIC TESTED **Tool Steel**



INOIS TOOL WORKS ANNOUNCES EXPANDED SIZE RANGE FOR CERTIFIED UNGROUND HOBS

3 D.P. TO 18 D.P. IN STOCK!

. up to 6 inches in diameter and with tapered holes where required. ow you can apply the proven advantages of *Certified* Unground obs—low original cost, reliable accuracy and longer sharpening life over a greatly increased size range. Write today for complete in- rmation.

emember, every *Certified* Unground Hob is shipped th the automatically produced Toolgraph* Chart, ur certificate of accuracy!

ND FOR YOUR FREE COPY OF THIS BOOKLET NOW!

. . . see the revised Metal Cutting Tool Institute tolerances for all classes of hobs. Detailed information will show you how you can reduce gear cutting ool costs with *Certified* Unground Hobs.

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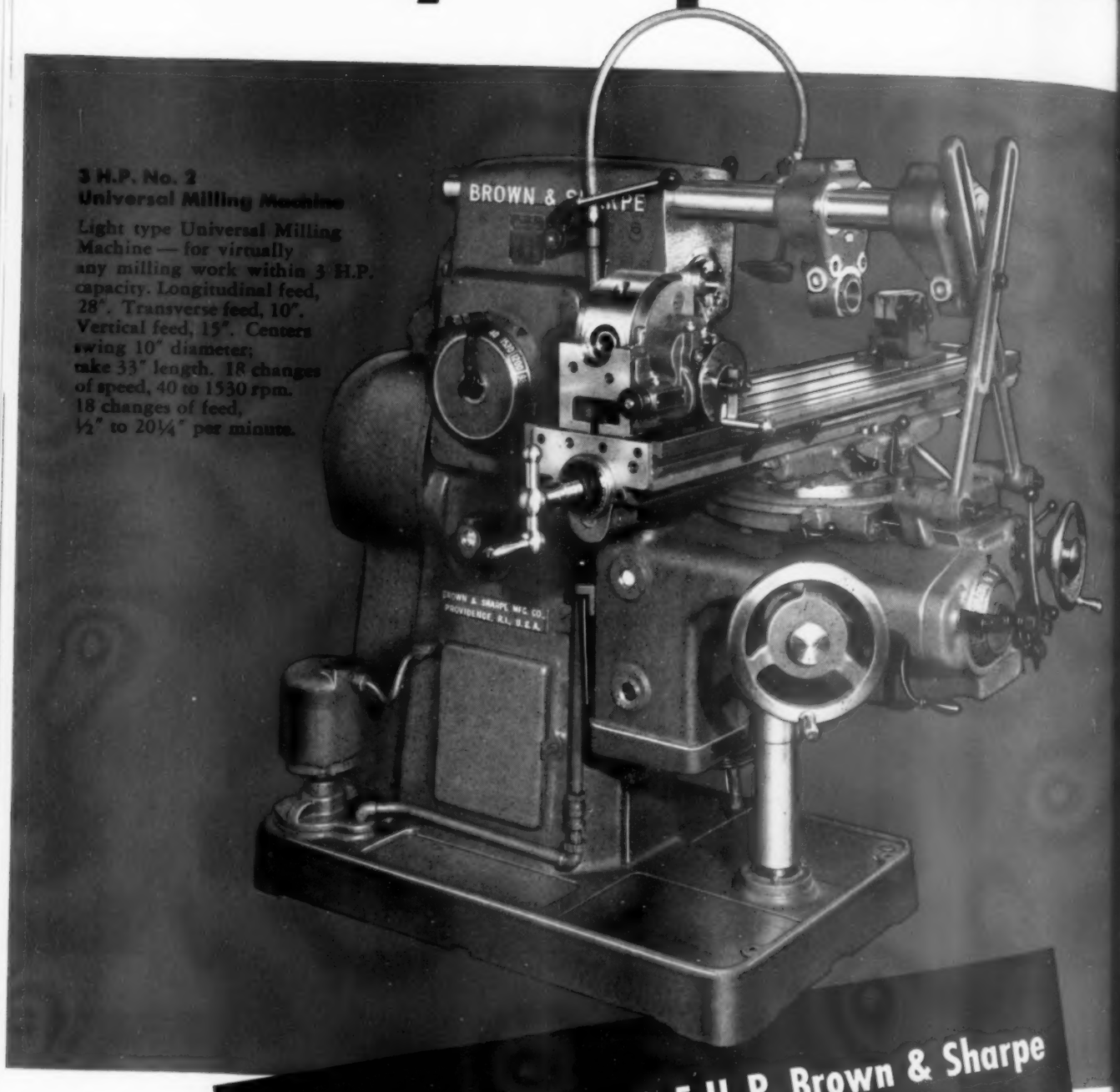
TOOL WORKS

2501 North Keeler Avenue, Chicago 39, Illinois

"HEADQUARTERS FOR ENGINEERED CUTTING TOOLS"

*T.M. Reg. U.S. Pat. Off.

Thrifty Preparedness



3 H.P. No. 2 Universal Milling Machine

Light type Universal Milling Machine — for virtually any milling work within 3 H.P. capacity. Longitudinal feed, 28". Transverse feed, 10". Vertical feed, 15". Centers swing 10" diameter; take 33" length. 18 changes of speed, 40 to 1530 rpm. 18 changes of feed, ½" to 20¼" per minute.

Shops equipped with 3 & 5 H.P. Brown & Sharpe No. 2 Universal Milling Machines have instant capacity for unusual as well as ordinary jobs

ss for all Milling Jobs...

5 H.P. No. 2 Universal Milling Machine

— somewhat heavier than the 3 H.P. machine. Longitudinal feed, 28". Transverse feed, 10". Vertical feed, 16½". Centers swing 10" diameter; take 31½" length. 18 changes of speed, 30 to 1200 r.p.m. 18 changes of feed, ½" to 20¼" per minute.

The extra versatility of these Brown & Sharpe Universals equips you to meet sudden demands for change-overs in milling jobs quickly and easily — prepares you to keep production at a continuously high level in spite of changes in models or products.

With both of these machines, production benefits from the more efficient tri-motor drive — for spindle, table, and coolant. This system of three independent motors eliminates much friction loss, increases machine flexibility, and assures full power at the cutter.

Other production-boosting features include quick selection of speeds and feeds; convenient, time-saving controls; automatic lubrication; and extended spindle face. Write for detailed bulletins. Brown & Sharpe Mfg. Co., Providence 1, R. I., U.S.A.

Brown & Sharpe B·S

INCREASE CARBIDE TOOL PRODUCTIVITY 300% to 400%

with FIRTHITE

MECHANICLAMPT TOOLS

- NO BRAZING OF TIPS
- NO "SPECIAL" GRINDING
- USE *STANDARD* TIPS—USE HARDER GRADES
- SPEEDY TIP ADJUSTMENT—USE MAXIMUM FEEDS & SPEEDS

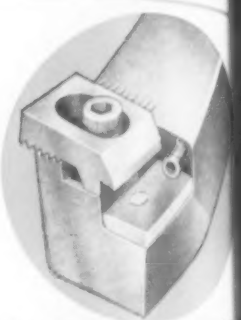
For Automatic Machining... ask about the NEWLY Improved

MECHANIGRIPT TOOLS

Completely redesigned, shop tested and proved. 8 points of superiority that makes the NEW Mechanigript Tools the most outstanding vertical insert tools.

Shop tested . . . perfected . . . and proved! Using STANDARD Stock Style 0000 carbide tips, the new Mechaniclampt design multiplies carbide tool productivity 3 to 4 times over brazed tools of the same tip size.

For Duplicator Contour Turning, Planing, Shell Turning, Boring; Engine Lathes, Turret Lathes, and General Machine Shop Use.



Renewable High Speed Steel Seat—Tip Replacement Quick and Easy.

SIX TOOL STYLES (right and

STYLE BRC (right)

STYLE FRC (right)

Offices and Warehouses:* HARTFORD, NEW YORK*, PHILADELPHIA*, PITTSBURGH*, CLEVELAND, DAYTON*, DETROIT, CHICAGO, BIRMINGHAM*, LOS ANGELES.

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STEEL & CARBIDE CORPORATION

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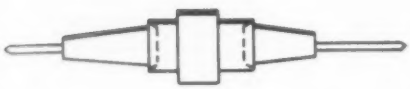
PETERMANN AUTOMATICS



Capacity 5/32″ diameter 1½″ length. Other sizes to 1″ diameter 6″ length.

Complete Tooling & Supply Service in New York since 1936.

RUSSELL, HOLBROOK & HENDERSON, INC.

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WHY GET INVOLVED...

in special design, drawings, tools, parts or any other "specials"? They almost always *increase costs, delay deliveries, reduce profits—"put you in the RED".*

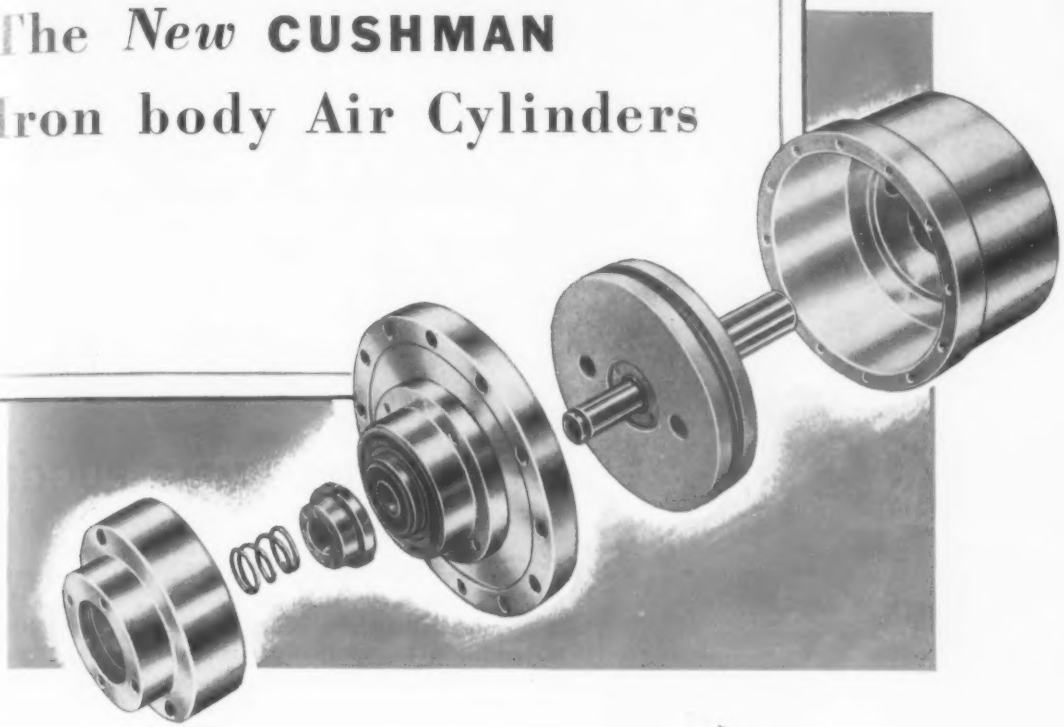
Whenever you use socket screw products—be sure you're not specifying "specials" where "standards" will do. Let us tell you how UNBRAKO Standard Socket Screw products—stocked by your local UNBRAKO Distributor—can help to "*keep you in the BLACK*". They're listed and described in our booklet, UNBRAKO "STANDARDS". Write for *your* copy today.

STANDARD recommends UNBRAKO® "Standards"

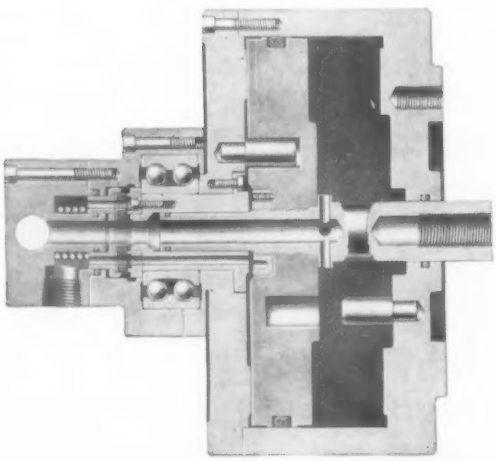
Knurled Head Socket Cap Screws
Flat Head Socket Cap Screws
Self-Locking Socket Set Screws
Knurled Head Shoulder Screws
Precision-Ground Dowel Pins
Fully-Formed Pressure Plugs

SPS STANDARD PRESSED STEEL CO.
JENKINTOWN 37, PENNSYLVANIA

The *New* CUSHMAN Iron body Air Cylinders



SIMPLE, RUGGED, PRECISION-BUILT UNITS YOU CAN INSTALL ON YOUR PRODUCTION LINE AND *FORGET*



These new iron body air cylinders follow the well-proved design of our very successful high speed aluminum body cylinders. They are suitable for operating either Cushman Air Chucks or those of other makes. Note these important features: —

Cylinder Body is one piece casting, light in weight, yet ample in section. Bore is precision bored and piston fitted with special "O" ring seal. In addition, operation is protected by a graphitar disc air seal (patent applied for) that is pressure balanced under load. You will have no trouble with air pressure leakage under heaviest recommended production loads.

Large air ports speed operation. Static balancing after assembly eliminates vibration. Installation, controls and operations are very simple.

Write for bulletin No. PO-8. And please anticipate your needs, since deliveries are tightly scheduled.

THE CUSHMAN CHUCK COMPANY, HARTFORD 2, CONNECTICUT

CUSHMAN CHUCKS

A World Standard for Precision

Cushman also manufactures Hand Operated Chucks, Power Operated Chucks and Electric Power Wrenches.

ON OLD OR NEW MACHINE TOOL OPERATIONS—

YOU CAN STEP UP YOUR PRODUCTION AS MUCH AS 30%

....WITH THIS SIMPLE, RUGGED, LOW COST AIR CYLINDER!

The pressure for production is on! Manufacturers everywhere find it increasingly difficult to keep pace with the demands of the day. But there is a way—a brand new way requiring no addition to manpower, no addition to plant facilities. The answer? Remarkable Bendix-Westinghouse Robotair Industrial Controls. With their wide range of applications, Robotair controls offer you amazing improvements in production speed and economy through increased productivity of man and machine at *unbelievably low initial cost.* Robotair units are available as original equipment for machinery manufacturers or for easy installation on shop equipment.

Send today for an informative booklet and find out how you can cut costs, speed production with Robotair! Address Bendix-Westinghouse Automotive Air Brake Co., Dept. H, Elyria, Ohio.

CHECK THESE FEATURES:

- ★ Frictionless
- ★ Leakproof
- ★ 100% efficient for total life
- ★ No oilers or filters needed
- ★ Holding pressures up to 5000 lbs.
- ★ Diaphragm has rolling action and exceptionally long life
- ★ Made from high grade steel stamping—all metal parts cadmium plated
- ★ Chrome Molybdenum Steel Push Rod heat-treated for maximum toughness
- ★ Easily installed

FOR HOLDING, CLAMPING, BENDING, SWEDGING, STAKING, RIVETING

ROBOTAIR

THE INDUSTRIAL AIR CONTROL OF A THOUSAND USES

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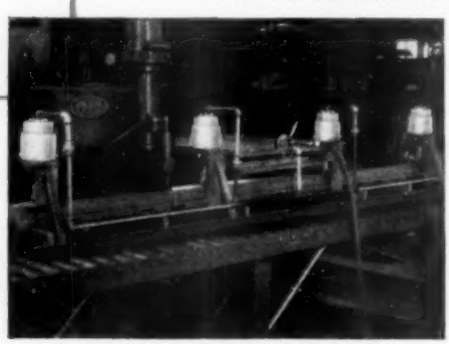
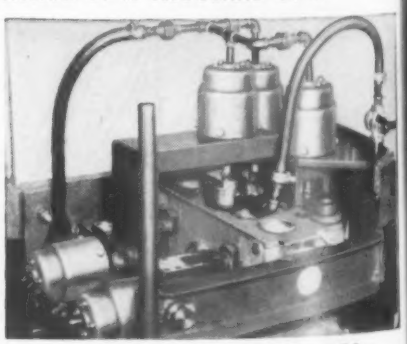
Bendix-Westinghouse Automotive Air Brake Company Elyria, Ohio



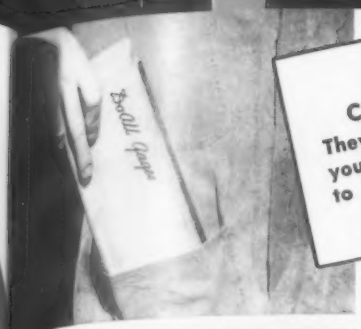
REDUCES OPERATOR FATIGUE

Four Rotochambers installed on the fixture in this spot welding operation replaced cumbersome hand clamps, saving time, greatly reducing operator fatigue.

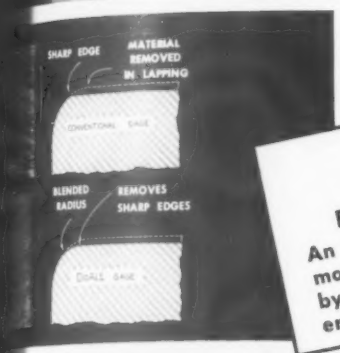


SPEEDS INSPECTION METHODS

Installation of Rotochambers on this water test operation for engine castings eliminated hand operated fixtures, thereby speeding inspection and cutting costs.



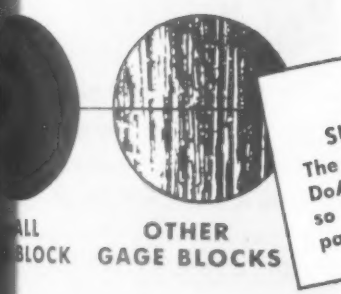
COMPACT CASE
They can be carried in your pocket; are easier to handle.



BURR-PROOFED
An exclusive process removes the edge burr left by lapping to give longer life, greater accuracy.

EASY TO USE
No fumbling to pick the blocks from the case — they stand up!

INDIVIDUAL CONTROL NUMBERS
Every block is numbered to keep sets matched, records accurate.



SUPER-FINE SURFACE FINISH
The primary reason why DoALL Gage Blocks last so long. Note the comparison.

These Exclusive DoALL GAGE BLOCK features . . . mean Better, Low Cost, Quality Control

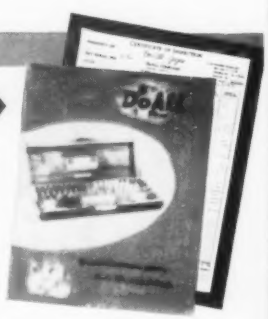
DoALL Gage Blocks are adaptable to literally thousands of critical inspection jobs. For example, with one set of 83 blocks and a few accessories *you can quickly make 120,000 different snap gages for about 1/4 cent each!* And you have micro-inch accuracy. DoALL Grade AA Gage Blocks are accurate to plus or minus two millionths of an inch; Grade A to four millionths; Grade B to eight millionths.

Use them for checking other instruments and finished parts. You cannot buy finer inspection equipment. DoALL Gage Blocks last longer, are easier to use, cost less in the long run than any others. *Ask to see DoALL Gage Sets at your plant*—your local DoALL Sales-Service Engineer will demonstrate them for you.

THE DoALL COMPANY, 254 N. Laurel Ave., Des Plaines, Ill.

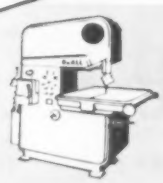
COMPLETE LINE OF ACCESSORIES
DoALL-developed accessories multiply Gage Block usefulness a thousand-fold.

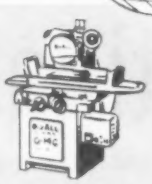
MODERN MEASUREMENT CONTROL
Send for this new 20 page Bulletin describing DoALL Gage Blocks and Accessories. Ask about DoALL Calibration Service for your present gage blocks!



DoALL

CALL DoALL FOR:



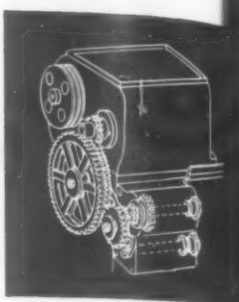


Machine Tools . . . Gaging Equipment . . . Tool Steel . . . Band Tools . . . Metal Working Supplie

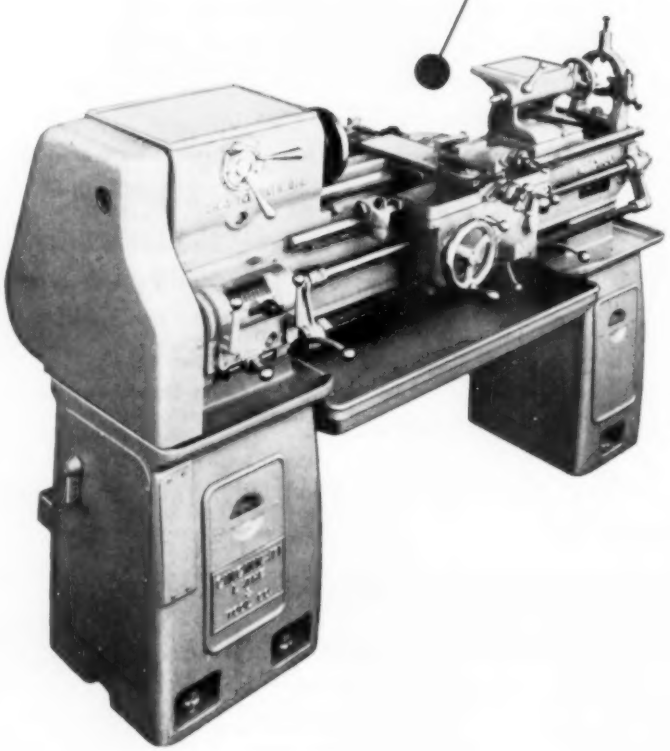
quick change artis

Reposition just 3 parts

Set up only two additional gears



from English to metric thread-chasing in about ten minutes*



Simple straightforward steps arrange your Tray Top light duty engine lathe to cut a full range of 48 metric threads and carriage feeds through the standard quick change box . . . quicker by far than for any other lathe, and more economical, too . . . What's more, you can change any of 12 spindle speeds (all geared, 40 to 1 overall ratio) in an instant, with 3-lever direct-reading color-match speed selector . . . And you can change setups because parking spaces on top of headstock and tailstock put mikes, tools, etc., at operator's fingertips, right where needed.

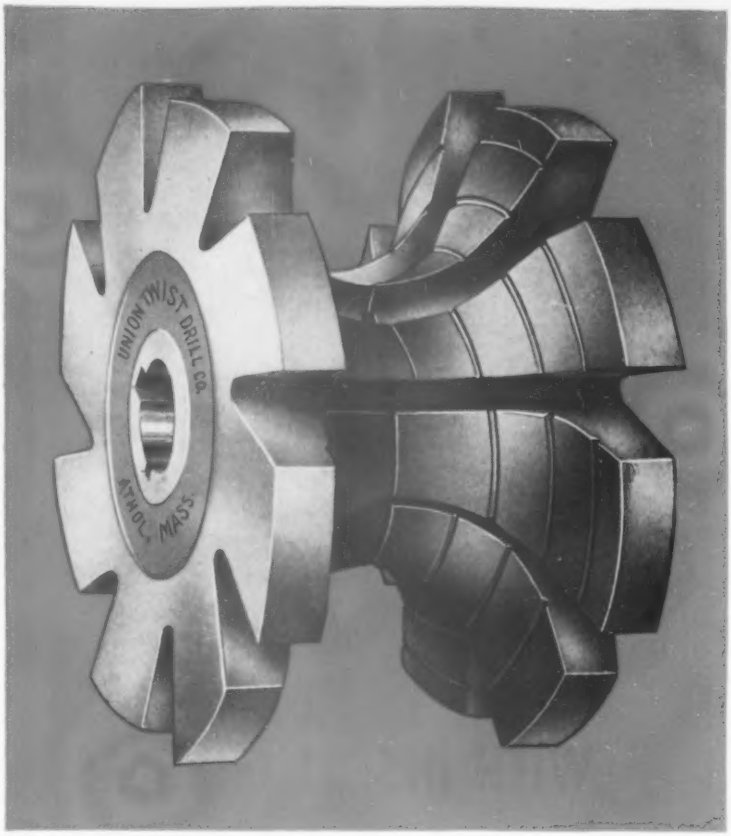
Your Tray-Tops are indeed quick change artists. Operators spend no time figuring, more time getting work out. Make your next light duty lathe a Tray-Top.

***required for many defense items.**

CINTILATHE
OF OUTSTANDING VALUE

CINCINNATI 9, OHIO, U.S.A. **cincinnati lathe & tool co.**

You get more duplicate parts... with UNION *Form Cutters*



MADE OF HIGH SPEED STEEL, Union form cutters are designed to cut with high accuracy within commercial limits. Where even greater accuracy is required, we are prepared to grind form cutters to much closer limits.

UNION FORM CUTTERS, as the name implies, are made to a certain outline or shape, for the production of parts which shall be duplicates, regardless of the number produced. Since they are ground on the face of the tooth, their form remains unchanged by repeated sharpening — when properly done — so that every piece milled during the life of the cutter will be a duplicate. And since, like all Union tools they are built to give extra-long service life, you'll find that Union form cutters are your surest bets for maximum production of duplicate parts with a single cutter — and for greatly reducing milling expenses in this type of operation.

FORM AND PROFILE CUTTERS IN GANGS

Many pieces now machined in successive stages may be more economically handled in one operation, using the proper gang of form cutters. Or, form cutters may be combined with plain mills, side mills and half side mills to finish the work in one set-up. We will be glad to suggest the proper assembly of cutters on receipt of your blueprint.

no other form cutter will outperform a UNION

contact your local distributor

His name is listed in Union's THOMAS' REGISTER insert under "Drills, Twist".

UNION TWIST DRILL COMPANY, ATHOL, MASSACHUSETTS

We own and operate S. W. CARD MANUFACTURING CO. Division, Mansfield, Mass. Taps, Dies, Screw Plates . . . BUTTERFIELD DIVISION, Derby Line, Vt., Taps, Dies, Screw Plates, Reamers . . . BUTTERFIELD DIVISION, Rock Island, Que., Milling Cutters, Twist Drills, Hobs, Reamers, Taps, Dies, Screw Plates.

DIE HEADS WITH INSERT CHASERS

For All Machines Used For Cutting Screw Threads

The famous H & G Die Heads come in styles and sizes for all types of machines, including threading machines, chucking machines, drill presses, turret lathes, and automatic screw machines, such as Brown & Sharpe, Cleveland, Cone, Davenport, Economy, Foote-Burt, Greenlee, Gridley, Acme-Gridley, New Britain, New Britain-Gridley, Swiss, etc.

The small, inexpensive high-speed steel insert chasers are held by rugged carriers and cut threads straight and true to the close tolerances required.

The majority of expert production men prefer these die heads because of the ease with which insert chasers are resharpened and set, the low cost of insert chasers and the greater quantity of threads per grind and number of pieces threaded per chaser dollar.

The reduction in inventory will pay for new die heads. **For example:** If you have $1,000 in chaser inventory, changing to H&G will require only $300, setting free $700 for the purchase of new H&G heads. This is due not only to low cost of chasers, but to interchangeability and long life.

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- ☐ "Selecting Proper Die Head for the Job"
- ☐ Style MM
- ☐ Style DMS
- ☐ Style DM
- ☐ Style TM

THE EASTERN MACHINE SCREW CORPORATION

27-47 BARCLAY STREET NEW HAVEN, CONN.

Mfrs. General Purpose Die Heads, Insert Chaser Die Heads, Threading Machines.

USE READER SERVICE CARD; INDICATE A-9-156-1

GEORGE L. *Detterbeck Quality Tools*

SPEED UP Screw Machine Production

SELECT YOUR NEEDS FROM THIS LIST

We specialize in

- CUTTING CAMS
- HIGH SPEED STEEL AND CARBIDE FORM TOOLS
- SPECIAL CUTTING TOOLS
- SPLIT DRILL BUSHINGS
- CROSS SLIDE KNURL HOLDERS
- TOOL BITS
- BOX TOOLS
- BURNISHING TOOLS
- REVOLVING STOPS
- RECESS SWING TOOLS
- FORMING SWING TOOLS

Inasmuch as we manufacture cams tools for the trade we obviously do on a production basis. As a result offer:

1. Superior type tools . . . at low
2. Practical design based upon years of experience.
3. Correct specifications which insure maximum service.

Your tool requirements in our hands your guarantee of better tools at great saving.

PROMPT DELIVERIES

Tool making with us is a routine matter. Special equipment . . . skilled hands . . . plus know how, enables to fill orders in a minimum of time

SERVICE

Let us quote on your tool requirements You'll save money . . . even as compared with "home made" tools. Standard circular form tools for Brown and Davenport Machines carried stock. Immediate delivery.

COMPLETE ENGINEERING

GEORGE L. DETTERBECK CO., Incorporated. 1871 Clybourn Ave., Chicago 14, Ill.

ENGINEERS TO AN INDUSTRY

USE READER SERVICE CARD; INDICATE A-9-156-2

Columbia TOOL STEEL

HEADER DIE STEEL—

Nothing equals sound, clean, uniform water hardening carbon tool steel for header dies.

Columbia Extra Header Die Steel is made to meet these requirements and will give top performance.

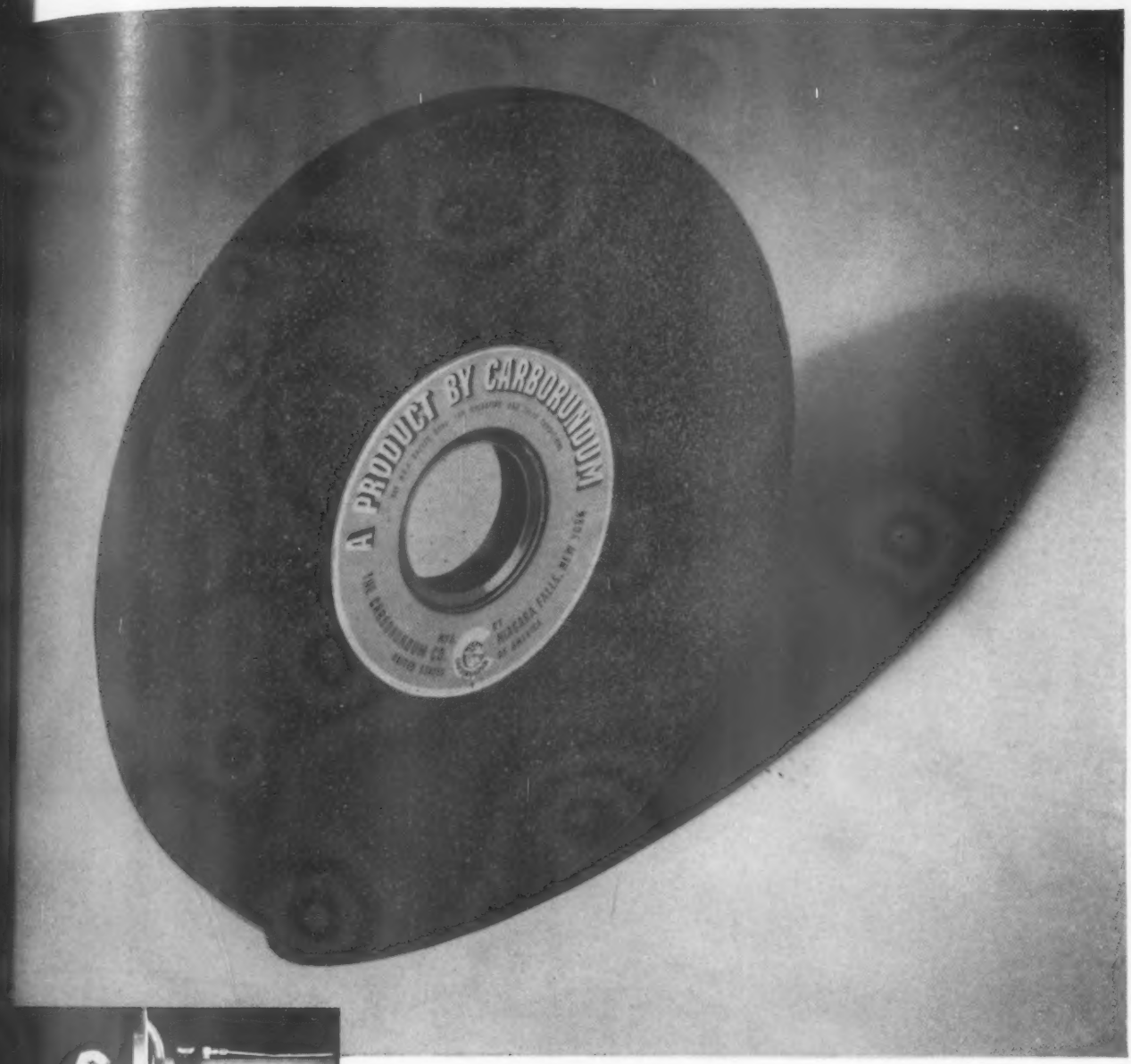
COLUMBIA TOOL STEEL COMPANY

ARTHUR T. CLARAGE, PRESIDENT

MAIN OFFICE AND WORKS

520 EAST 14TH STREET • CHICAGO HEIGHTS, ILL.

USE READER SERVICE CARD; INDICATE A-9-156-3



"GREEN-GRIT" *Wheels by* CARBORUNDUM

Lasts Longer in Carbide Grinding

Exceptional strength is a primary characteristic of "Green-Grit" VR Bond Wheels by CARBORUNDUM. Superior form holding qualities lead to higher accuracy and increased production savings in the tool room. Complete range of grades available to meet varied requirements. Your CARBORUNDUM representative can give you complete information, or Dept. TE 81-19.

Only CARBORUNDUM

TRADE MARK

makes ALL Abrasive Products ...to give you the proper ONE

"Carborundum" and "Green-Grit" are trademarks which indicate manufacture by The Carborundum Company, Niagara Falls, N. Y.

PARKER • MAJESTIC PM PRECISION MACHINES

Above is pictured the home and products of the

PARKER-MAJESTIC, INC.

For over twenty-one years this company has manufactured the Parker Spindles used in Precision Grinding, Boring and Milling applications.

Supplementary products include the well known line of Parker-Majestic Internal, External, No. 2 Surface and Rotary Surface Grinders.

Descriptive literature upon request.

PARKER-MAJESTIC, INC.

formerly **MAJESTIC TOOL & MFG. CO.**

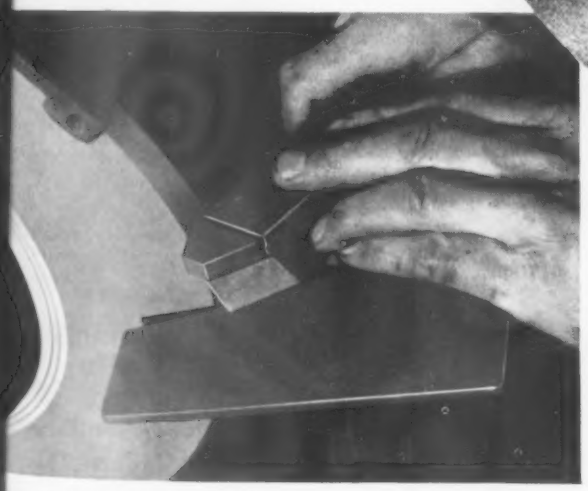
147 JOS. CAMPAU • DETROIT 7, MICHIGAN

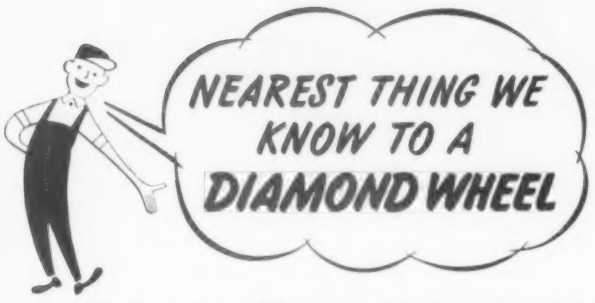
EW "XL" BOND FOR CARBIDE
OOL AND CUTTER GRINDING

ssures Efficient Performance at Far Lower Cost!

really big news . . . this new "XL" Bond! L" is the name of Chicago Wheel's remarkle new line of silicon carbide vitrified grindwheels . . . especially made for carbide tool d cutter grinding.

"XL" wheels come in the most popular tool d cutter sizes and steel backs. They're deigned for efficient, economical, rough and fin grinding . . . offhand or precision automatic. nd they're already proving themselves on the , helping to keep the nation's carbide tools d cutters in first-class shape for the mobilizaon program. "XL" is unexcelled . . . and anher 1st for Chicago Wheel!





WRITE NOW!
Send for literature and engineering report on the new "XL" Bond Silicon Carbide Grinding Wheels.

CHICAGO WHEEL & Mfg. Co.
1101 West Monroe Street, Chicago 7, Illinois

OFFICES IN PRINCIPAL INDUSTRIAL CENTERS

CHICAGO WHEEL & MFG. CO. Dept. T E
1101 West Monroe Street, Chicago 7, Illinois

Name.....

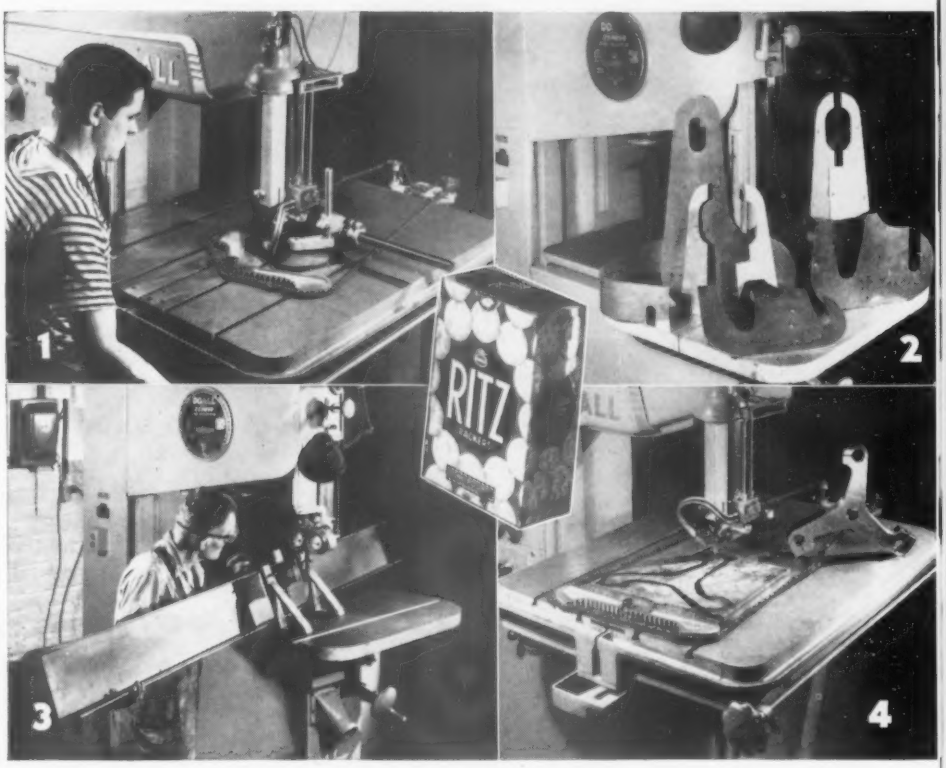
Firm.....

Address.....

City.....Zone.....State.....

HOW NABISCO BENEFITS FROM DoALL BAND MACHINING

DES WORK FASTER; CUTS LL KINDS OF SHAPES; ACHINES BRASS, BRONZE, LUMINUM, CAST IRON, TAINLESS, HARD TOOL STEEL; ETS FINER, ORE ACCURATE CUTS



- Circular parts cut automatically using disc cutting attachment and hydraulic power feed.
- Sheet steel parts for packaging machinery produced quicker by friction sawing.
- Friction sawing steel channel on DoALL Zephyr Band Machine.
- Contour sawing irregular shapes from solid steel 2" thick by 14" square.

AT National Biscuit Company's machine shop in Evanston, Illinois, DoALL Band Machines really earn their keep. They work all the time on all kinds of jobs. They cut any material—even the hardest steel. One job originally calculated to take a week's time was done in three days on the DoALL MP-20. Other work formerly done on milling machines is now done much faster at less cost on DoALL's.

You can have benefits like these. Ask to have a FREE DEMONSTRATION of a DoALL Band Machine in your own plant. Call your local DoALL Sales-Service Store or write:

THE DoALL COMPANY • 254 N. Laurel Ave. • Des Plaines, Illinois

B-2

ND FOR CATALOG

ut jobs that DoALL achining can do for out about blades for ery material; how saw, grind, hone, riction saw — cut . Write today.

INDUSTRY'S NEW TOOLS

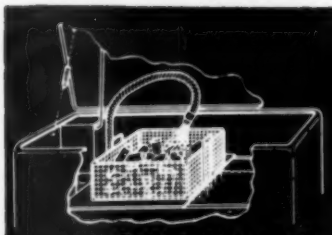
DoALL

27 SALES-SERVICE STORES

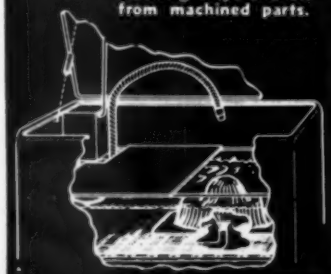
LL DoALL FOR:

Machine Tools . . . Gaging Equipment . . . Tool Steel . . . Band Tools . . . Metal Working Supplies

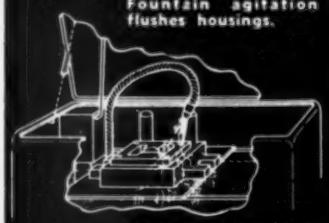
This is How GRAYMILLS AGITOR Saves on Hard - To - Get Chlorinated Solvents and Provides a Low-Cost Parts Cleaning System For Production, Maintenance and Service Departments



Flushing chips and oil from machined parts.



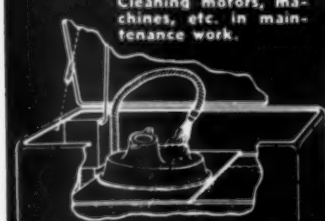
Fountain agitation flushes housings.



Cleaning Dies, Jigs, and Tools.

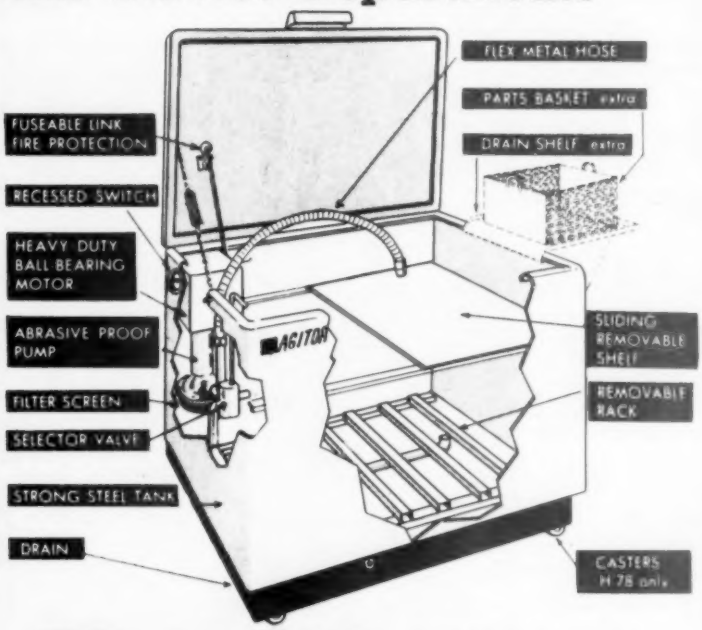
Cleaning stampings for inspections.

Cleaning motors, machines, etc. in maintenance work.



Cleaning parts before service or repair.

Flushing holes in hydraulic and similar parts.



AGITORS MADE IN 3 SIZES

MODEL H78
50 Gallons
38" x 21" x 34"
$184.50

MODEL H81
100 Gallons
41" x 30" x 38"
$259.50

MODEL H95
200 Gallons
58" x 34" x 38"
$495.00

Special filter units can be supplied where "extra clean" solvent is required for rinsing.

GRAY-MILLS AGITOR PARTS CLEANING SYSTEMS

More and more plants are discovering an inexpensive solution to many of their parts cleaning problems . . . by installing one or more Agitors. They are used in production, maintenance and service departments.

There is an immediate saving because Agitors use safe, effective, low-cost *Cold* solvents, that are easy-to-get, require no heating and waiting.

Some plants use Agitors exclusively for their cleaning . . . and, many more plants effect savings in time and in the cost of solvents by using Agitors for between operation cleaning or to take a load off of their vapor-degreasers.

On such application, parts are flushed first in the Agitor to remove the cutting oil, chips, grit . . . and vapor-degreasers are used for the final cleaning. By precleaning in an Agitor you'll get "more mileage" from the chlorinated solvents used in vapor-degreasing. A Model H78 Agitor pays for itself in one month by saving just two drums of expensive chlorinated solvent.

Agitors provide an inexpensive cleaning method for many jobs that do not warrant a high-priced engineered cleaning system. Over 12,000 Agitors now in use.
Write Today for information on how you can save time and money on your parts cleaning problems.

WRITE TODAY FOR NEW AGITOR CATALOG

Only AGITOR Gives You Exclusive 3-Way Action To Save Cleaning Time and Assure Clean Filtered Solvents For Rinsing

1. Solvent discharged jet-like agitates tank for soak cleaning.

2. Fountain like discharge for large parts.

3. Stream of solvent thru hose used for flushing off parts and assemblies.

GRAYMILLS CORPORATION, 2016 RIDGE AVENUE, EVANSTON, ILLINOIS

CARD
Ground Thread
TAPS

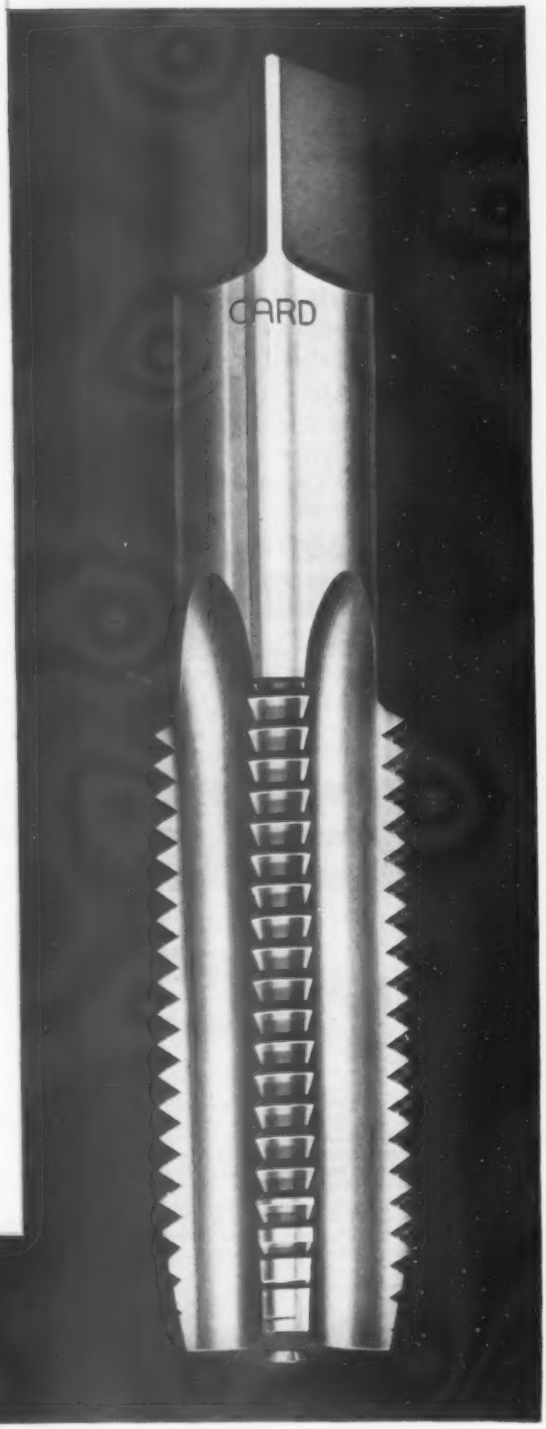
Extra protection...
At no extra cost!

Every tap, every cutting tool made by Card gets a rigid factory-inspection. That's routine — but it's only half the story. We also employ the Pittsburgh Testing Laboratory to buy Card Taps on the open market — at places and times unknown to us — and check them again, certifying the results.

This means extra protection for you — at no extra cost. *Because you can buy Card Certified* Taps at the same price you'd pay for run-of-the-mill taps!*

Why be satisfied with anything less than Card's double-checking—with its double assurance of dependability and long, money-saving service life? . . . Contact your Card Distributor for the quality taps you need — and for prompt, cooperative service at all times.

Card Ground Thread Taps are available in both commercial and precision ground threads. When precision ground is required, be sure to specify the limit number.



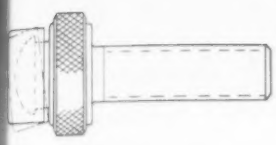
TAPS
The Certified Cutting Tools*
*by the Pittsburgh Testing Laboratory
Also makers of DIES • SCREW PLATES
DIE STOCKS • TAP WRENCHES

S. W. CARD
MANUFACTURING COMPANY
Mansfield, Massachusetts
DIVISION OF UNION TWIST DRILL CO.

NEW! VLIER TOGGLE PADS

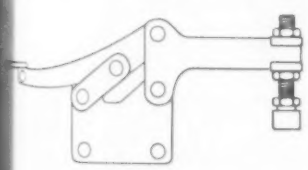
...tools with 1001 uses!

Pat. Appld. for

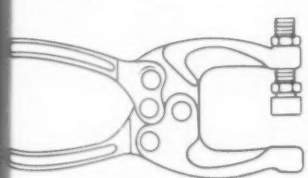


Toggle pad on Vlier Torque Thumb Screw

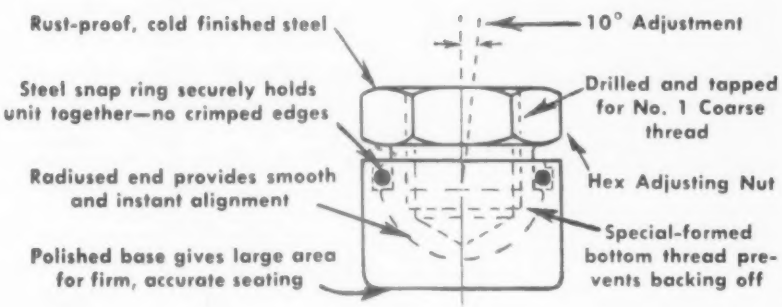
Toggle pad in use with a jack



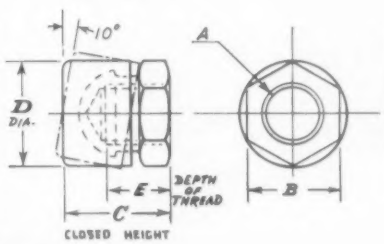
Toggle pad demonstrated on a toggle clamp



Toggle pad on toggle pliers



This latest addition to the Vlier line of tool specialties (Torque Thumb Screws, Spring Plungers, Spring Stops and Fixture Keys) fills a great need among all types of industries. In fact, wherever clamping is done, the Vlier Toggle Pads are practical necessities. These tools are designed to operate with almost any type of clamp—some of which are shown on this page—and they insure solid, secure holding because of their self-aligning and leveling feature. The pad base has a 10° movement for permitting adaption to uneven or off-angle surfaces. Each tool has a "jamming" feature to prevent loosening during work, yet it is easily removed. All Vlier pads are made of the finest cold finished steel and accurately machined for trouble-free performance. See these inexpensive but necessary tools today—they save real money on production lines. Your nearby Vlier representative will be happy to demonstrate them.



ITEM No.	A	B	C	D	E
P-300	1/4-20	1/2 Hex.	5/8	5/8	13/32
P-302	5/16-18	9/16 "	11/16	11/16	27/64
P-304	3/8-16	5/8 "	3/4	3/4	1/2
P-306	1/2-13	3/4 "	7/8	7/8	17/32
P-308	5/8-11	7/8 "	15/16	1	9/16

VLIER MANUFACTURING CO.

4552 Beverly Blvd., Los Angeles 4, Calif.
Phones: GLadstone 2775 — 2941

Index of The Tool Engineer Advertisers

SEPTEMBER, 1951

The Index to Advertisers is published as a reader service. Although every precaution is taken to assure correct listing, no allowance will be made for error or omission.

THE TOOL ENGINEER REGIONAL ADVERTISING OFFICES

EASTERN	OHIO	CENTRAL	WESTERN	PACIFIC COAST
Austin G. Cragg 400 Madison Ave. Phone: Plaza 9-4018 New York 17, New York	Richard E. Cleary Commercial Bank Building Phone: Berea 4-7719 Berea, Ohio	Clarence T. Etter 10700 Puritan Avenue Phone: University 4-7300 Detroit 21, Michigan	Stanley F. Girard 540 N. Michigan Ave. Phone: Michigan 2-4465 Chicago 11, Illinois	W. R. McIntyre 423 First Trust Bldg. Phone: Ryan 1-6981 Pasadena 1, California

There's a BENCO PUSHER that will do your particular job better

● When a question arises concerning the proper type of pusher to use, the answer is "there is a Benco Pusher that will do your particular job better!" Among the many types of Benco Pushers are solid, squirrel cage, heavy duty cage type, "Multi-Split" and Master with alloy pads.

In order to provide proper spring tension and a **hard bearing** area only selected bar stock is used. In addition, the bearing sections are accurately hardened, assuring long lasting, trouble-free operation. Thread tolerances are carefully checked to insure snug fit in the feed tube.

Benco Pushers always feed smoothly and properly without damaging the stock. With Benco Pushers you get more production and reduce stock waste on simple feeds or difficult work such as high speeds, long feed-outs and scratchless operations.

For twenty-five years, leading manufacturers have been producing more and better work with Benco Collets and Pushers. It will pay you to specify Benco if you want to increase the performance of your machines. Most standard sizes are carried in stock for immediate delivery.

SEND FOR OUR CATALOG AND PRICE LIST

BENCO COLLET MANUFACTURING CO.

1560 EAST 27th STREET CLEVELAND 14, OHIO

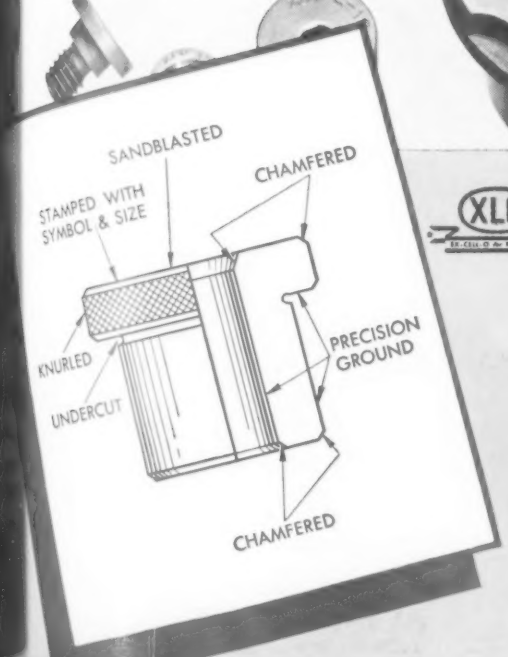
Always Better Constructed

Accurate Benco Collets, Pushers and Pads

ook for These Features in Drill Bushings

EX-CELL-O HAS THEM ALL

- **MATERIAL**—premium grade tool steel selected for greatest wear resistance.
- **FINISH**—precision ground inside and out, and under the head for perfect bearing.
- **CONCENTRICITY**—assured by grinding on arbors after the holes are finished.
- **HARDNESS**—hardened to 62-64 Rockwell "C" on accurately controlled equipment.
- **UNIFORMITY**—of material, dimensions, finish, and hardness assure accuracy, long life for both bushings and tools.
- **PROMPT DELIVERY**—from stocks of standard sizes in Detroit, New York, Los Angeles, and Toronto, Canada.
- **PREFERRED**—largest bushing users in the country are Ex-Cell-O customers.



XLO

Your purchasing and engineering departments should have copies of this Ex-Cell-O Bushing Catalog No. 35371. Just ask for the number of copies you would like.

EX-CELL-O CORPORATION

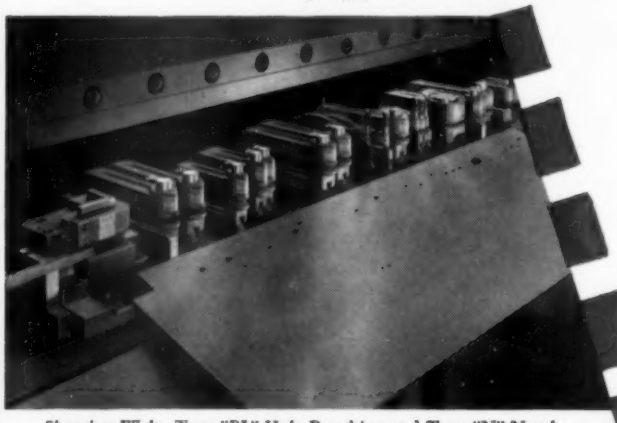
DETROIT 32, MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS • CUTTING TOOLS
RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT
AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

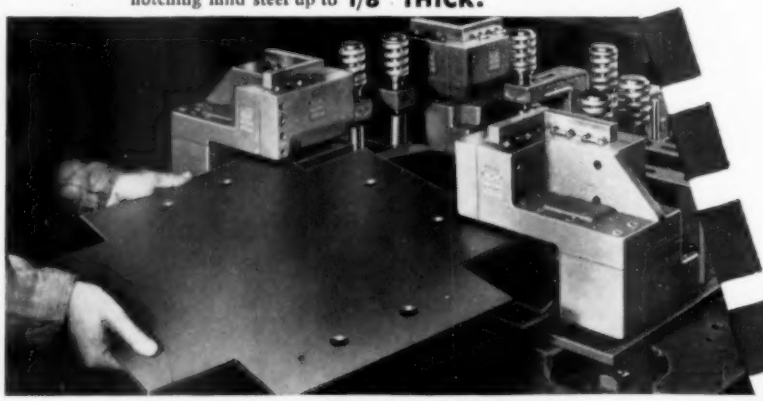
Punching ⅛", ¼", ½" thick mild steel

THERE ARE WALES HOLE PUNCHING UNITS TO DO THE JOB

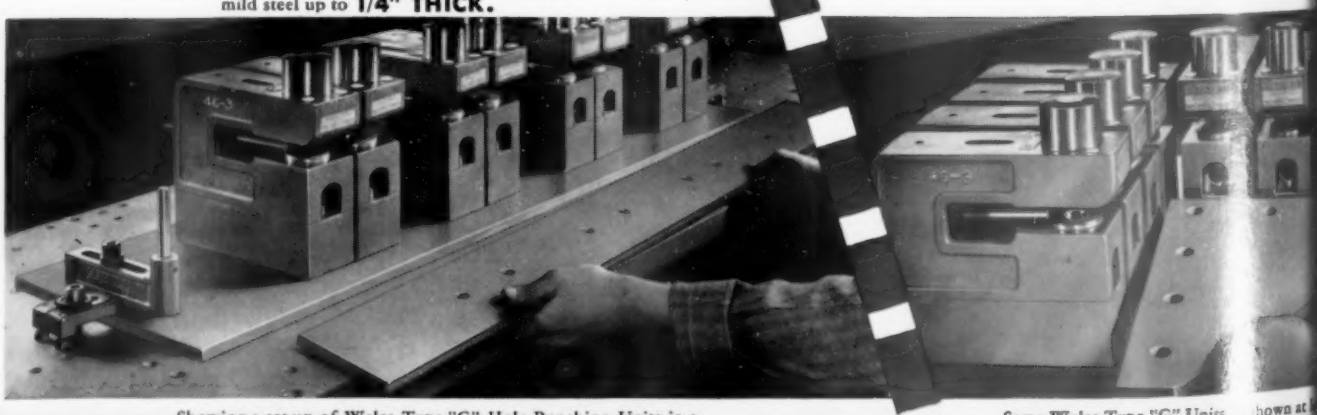
AND NOTCHING UP TO 1/4" THICK MILD STEEL



Showing Wales Type "BL" Hole Punching and Type "N" Notching Units in a combination press brake set-up for punching and notching mild steel up to **1/8" THICK.**



A stamping press set-up of Wales Type "CJ" Hole Punching and Type "NJ" Notching Units for punching and notching mild steel up to **1/4" THICK.**



Showing a set-up of Wales Type "G" Hole Punching Units in a

Same Wales Type "G" Units shown at

● Only America's most complete line... the Wales Line provide the exact *standard* hole punching unit required f thickness of metal up to ½" thick.

In most applications, hole punching and notching m accomplished in the same operation on both stamping p and press brakes. Wales independent, self-contained which hold the punches and dies in permanent alig permit set-ups to be made outside the press and on press bed reducing expensive press "downtim an absolute minimum. Die sets are not necessar Wales self-contained Units.

The *multiple* time-saving, money-saving advant Wales Hole Punching and Notching Equipm too BIG a story to tell in this space, so write fo illustrated, functionally colored catalogs TO

WALES-STRIPPIT CORPORAT

GEORGE F. WALES, *Chairman*

393 **PAYNE AVE., N. TONAWANDA, N**

(Between Buffalo and Niagara Falls)

WALES-STRIPPIT OF CANADA, LTD., HAMILTON, O

Specialists in Punching and Notching Equ